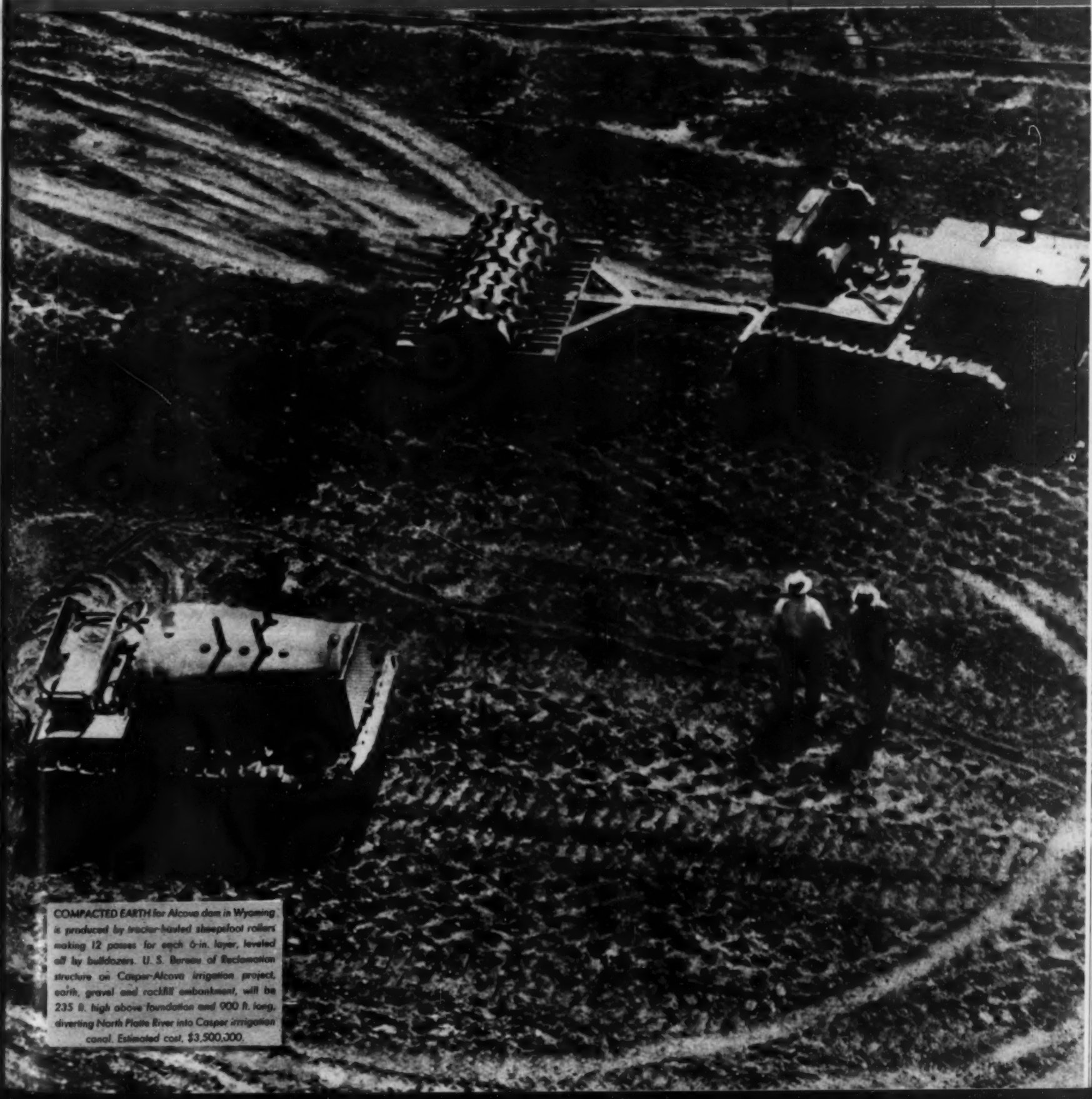
Construction Methods

McGraw-Hill Publishing Company, Inc.

November, 1936

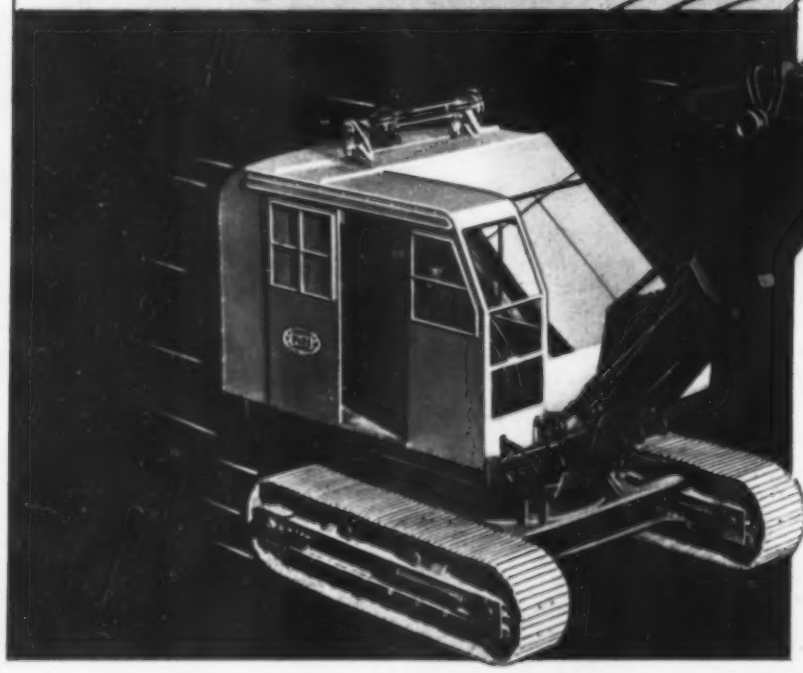
PUBLIC LIBRARY
NOV 19 1936

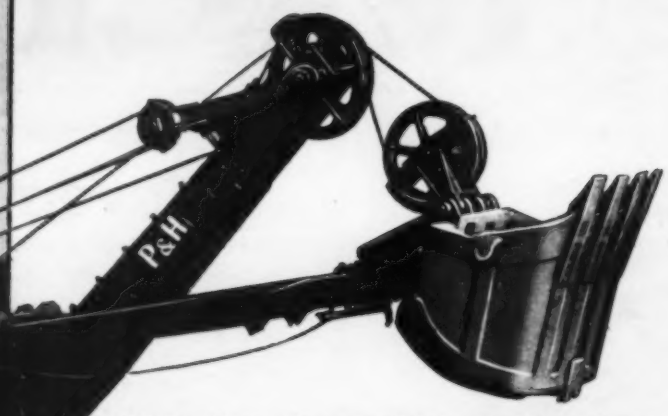
Price 20 Cents



COMPACTED EARTH for Alcova dam in Wyoming is produced by tractor-hauled sheepsfoot rollers making 12 passes for each 6-in. layer, leveled off by bulldozers. U. S. Bureau of Reclamation structure on Casper-Alcova irrigation project, earth, gravel and rockfill embankment, will be 235 ft. high above foundation and 900 ft. long, diverting North Platte River into Casper irrigation canal. Estimated cost, $3,500,000.

THE NEW P&H MODEL 455 Steps Out—





With New Pacemaking Performance for 1-Yd. Excavators

LIGHTER, FASTER, EASIER TO RUN

Another great step in a great program! A brand new 1-yd. machine joins the ranks of the P&H Pacemakers! Old ideas are discarded to gain speed, stamina and lower operating costs. Welding of new alloy steels makes it *much* lighter, *much* stronger, *much* faster to set a new production pace in the 1-yd. shovel class!

Diesel power . . . split-second power clutches . . . live boom . . . rapid reversing chain crowd . . . two-speed transmission . . . with automotive-type foot pedals and light-touch levers give the operator direct "feel" of all loads for faster, easier operation

You know what it takes to make an excavator earn money for its owner. See what this new 455 does to increase profits on all kinds of jobs. Ask for complete details.

Powered by Diesel (gas also available)

Fully convertible for six types of service with light attachments of alloy steel.

THE ONLY 1-YD. MACHINE TO GIVE YOU ALL THESE NEW ADVANTAGES

1. ***Tractor-Type Crawlers "take" to the ground***
   Faster travel, easier control, better mobility in these tractor-type crawlers of universally approved design.
2. ***Welded Frame of high tensile steel***
   Cylindrical car body with X-frame is welded integrally with the corduroy frames of alloy steel channel for greater strength and lightness.
3. ***Helical-geared hoist mechanism***
   Smooth, quiet, power transmission with all helical hoist gearing fully enclosed, running in an oil bath for long life.
4. ***Live roller circle with hook rollers***
   The upper revolves on a huge roller bearing. Double swiveled rollers at the back take up all tipping strain for easy swing with full dipper loads.

JUST OFF THE PRESS!

This new bulletin No. X-11 describes the new model 455. Your copy is waiting for you. Write for it today.

HARNISCHFEGER CORPORATION
Established 1884
4494 W. National Ave. Milwaukee, Wis.
Warehouses and Service Stations: Hoboken, Memphis, Jacksonville, Seattle, Dallas, Los Angeles, San Francisco

P&H PACEMAKERS—FASTER ON THE JOB

TECHNOLOGY DEPT.

CURRENT JOBS

...and Who's Doing Them

Buildings

Public — Another PWA Housing Division contract, amounting to $1,515,782, has been let at Birmingham, Ala., to **Algernon Blair**, of Montgomery, Ala., covering superstructure for Smithfield Court project. In Washington, D. C., a $1,042,930 contract for a government printing office warehouse went to **C. H. Tompkins**, of Washington. For a sanatorium at Tallhina, Okla., the successful joint bidders were **S. Patti Construction Co.** and **Manhattan Construction Co.**, of Muskogee, with a price of $857,732. A grain elevator contract in Kansas City, Kan., went to **Nicholson Co.**, of New York City, for $857,000. **A. A. La Fountain**, of Hackensack, N. J., is building a state armory at Teaneck, N. J., for $480,691. Hospital ward buildings at Dixon, Ill., were bid in by **A. Smith & Co.**, of Chicago, for 794,750. For medical center building in Jersey City, N. J., **J. Mitchell, Inc.**, of Jersey City, submitted low bid of $763,000. In Los Angeles, Cal., **Weymouth-Crowell Construction Co.**, and **R. S. Campbell**, of Los Angeles, have a $573,700 contract for college buildings. A law school building in Baton Rouge, La., went to **Caldwell Bros. & Hart**, of New Orleans, for $678,913. **Charles T. Wills, Inc.**, of New York, is building a gymnasium at West Point, N. Y., for $735,000.

Commercial — Under separate contracts at Buffalo, N. Y., the **Landowners' Rehabilitation Corp.**, is building the $4,000,000 Lakeview housing project. An apartment at 1115 Fifth Ave., New York City, to cost $1,000,000, is under construction by **Hegeman-Harris Co.**, of New York. Another $1,000,000 job for a university hospital wing at Nashville, Tenn., was obtained by **Foster & Creighton Co.**, of Nashville. In Columbus, Ohio, **E. J. Frankel** and **Nelson Pedley, Inc.**, are building a $750,000 6-story apartment. **Day & Sachs**, of Birmingham, Ala., are building a $500,000 store in that city for S. H. Kress & Co.

Industrial — With its own forces the **Manganiferous Mining Co.** is constructing a $2,000,000 ore concentration plant at Trommaid, Minn. A $2,000,000 sugar refinery at Woodland, Calif., for Spreckels Sugar Co., is under way by **Dinwiddie Construction Co.**, of San Francisco. The **J. W. Cowper Co.**, of Buffalo, N. Y., was successful bidder, at $1,000,000, for a plant building at Tonawanda, N. Y., for Linde Air Products Co. An $800,000 factory is being built in Cincinnati, Ohio, for W. S. Merrell Co., by **F. Messer Sons, Inc.**, of Cincinnati.

Highways

The following are among the leading highway contracts let last month: In Ohio, $459,790 for paving and grade crossing elimination in Cuyahoga County to **Horvitz Co.**, of Cleveland. In Massachusetts, $484,008, for sidewalk construction in Easthampton and Holyoke to **Daniel O'Connell's Sons, Inc.**, of Holyoke; $281,112 for bituminous surfacing in Pembroke and Marshfield to **A. G. Tomasello & Son**, of Boston. In Iowa, $349,671 for paving 13.4 mi. in Buena Vista County and $408,414 for paving 16.9 mi. in Cherokee County, to **Union Paving Co.**, of Des Moines, Ia. In California, $387,483 for concrete and bituminous paving and grading on Santa Monica Boulevard, in Los Angeles, to **Gogo & Rados**, of Los Angeles; $336,375 for Santa Monica Boulevard paving in Los Angeles, to **Southwest Paving Co.**, of Roscoe, Cal. In New York, $404,358 for grading and structures in Franklin County, to **Belmar Contracting Co.**, of Troy, N. Y.; $309,396 for paving in Columbia County to **Lane Construction Co.**, of Meriden, Conn. In Pennsylvania, $296,486 for concrete paving in Berks County to **C. W. Good**, of Lancaster, Pa. In Connecticut, $242,263 for sheet asphalt in Hartford to **M. A. Gammino Construction Co.**, of Providence, R. I. In Georgia, $335,685 (two contracts) for paving in Effingham and Sumpter Counties, to **Whitley Construction Co.**, of La Grange; $518,883 (two contracts) for paving and four bridges in Dawson, Coffee and Telfair Counties to **W. L. Cobb Construction Co.**, of Decatur, Ga.

Construction Methods

Copyright, 1936 McGraw-Hill Publishing Co. Inc., 330 West 42nd St., New York

ROBERT K. TOMLIN, Editor — **NOVEMBER, 1936** — WILLARD CHEVALIER, Vice-President

Editorial Staff: Vincent B. Smith, John B. Huttl (San Francisco) Nelle Fitzgerald

The "How" of it:

(For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

How SHEEPSFOOT TAMPERS of exceptional weight, in tandem units, compacted rock fill for big dam. — p. 25

How SAFETY NET under Golden Gate bridge insures workers against 220-ft. drop into water. — p. 26

How GLASS BLOCK WINDOWS eliminate steel sash in mill building subject to acid fumes. — p. 26

How FAST SEWER CONCRETING was done by twin paving mixers. — p. 27

How PNEUMATIC-TIRED WAGONS AND TRUCKS handled material for thirteen earthfill dams. — p. 28

How CROWN is provided in building earth dam embankment to drain rain water rapidly. — p. 31

How BATTER BOARDS on upstream face of earthfilled dam insured true subgrade for riprap. — p. 32

How VACUUM-COMPRESSION METHOD was used to treat concrete slab on bridge roadway. — p. 33

How NO-SLUMP CONCRETE was produced by removing excess water from mix in place. — p. 33

How BUILDING ERECTION NOISE was abated by welded and bolted connections. — p. 34

How STRUCTURAL CONNECTIONS were made economically on steel-frame office building. — p. 35

How TACK WELDING held nuts on bolted connections after tightening. — p. 35

How PENETRATION MACADAM road surface was built on native stone base. — p. 36

How SUBGRADE DRAINS, filled with crushed rock, removed water from pavement base. — p. 37

How ALUMINUM BODY on dump-truck reduced dead weight and increased pay load. — p. 37

How SHEET METAL PAN prevented "fat" spots at start of bituminous application by pressure distributor. — p. 39

How BITUMINOUS SHOULDER of highway was mixed in place by six-blade drag. — p. 46

How TRUCK DERRICK handled stone for highway guard rail. — p. 46

How BACKFILL for pipe line trench was placed by tractor-bulldozer. — p. 46

How TRUCK DRIVER PROTECTION was afforded by curved shields of corrugated metal — p. 47

How EXTRA YARDAGE was obtained with carryall scraper by raising front apron. — p. 47

How PNEUMATIC GUN applied sand-cement mix to monolithic structures. — p. 48

How CONSTRUCTION INSPECTION is improved by training at special school on job. — p. 50

Bridges

Grade crossing elimination structure at Buffalo, N. Y., went to **J. W. Cowper Co. Inc.**, of Buffalo, for $953,473. Massachusetts let following bridge contracts: To **C. J. Maney Co.**, of Boston, four-span structure over B.&M. R.R. and paving at Saugus, Revere and Malden for $825,178; to **B. Perini & Sons**, of Framingham, bridges on Newburyport turnpike for $167,093, $1,349,895, and $325,390; to **New Haven Road Construction Co.**, of New Haven, Conn., bridges and paving in Millbury and Sutton for $486,986. For a bridge on the Belleville Turnpike in New Jersey **P. T. Cox Contracting Co.**, of New York, bid $517,306. On Florida's overseas road and toll bridge project, **C. Y. Tommason Co.**, of New Orleans, bid $365,490 for bridge and roadway. For a concrete bridge in Ashtabula County, Ohio, the low bidder was **Constructors & Engineers, Inc.**, of Chicago, with a price of $259,376. North Carolina bridge contract at Fear River, Fayetteville, went to **T. A. Loving & Co.**, of Goldsboro, for $236,229. At Iselin, N. J., a $208,835 steel bridge was bid in by **J. Rich Steers, Inc.**, of New York.

Dams

Contract for the Conchas dam at Tucumcari, N. M., was awarded by U. S. Engineer Department to **Bent Bros.** and **Griffith Co.**, of Los Angeles, Cal., for $4,587,676. At Alton, Ill., **Engineering Contracting Co.**, of New York, bid in for $1,159,841 the twin locks at Dam No. 26 on Mississippi River. For the Marshall Ford dam on the Lower Colorado River, near Austin, Tex., a joint low bid of $5,781,350 was submitted by **Brown & Root**, of Austin, and **McKenzie Construction Co.**, of San Antonio.

Waterworks and Sewerage

At Salem, Ore., a $649,272 steel and concrete pipe contract for new waterworks went to **American Concrete & Steel Pipe Co.**, of Tacoma, Wash. To **J. Gill & Sons Co.**, of Cleveland, Ohio, went a $533,640 sludge and sewage filter structure in that city. Atlanta, Ga., gave the **Hardaway Contracting Co.**, of Columbus, Ga., $371,000 contract for sewage disposal plant. For superstructure at Ward's Island sewage treatment plant, New York City, low bidder was Cauldwell-Wingate Co., of New York, with price of $1,547,175. Greensboro, N. C., let a $499,000 sewage plant contract to **V. B. Higgins & Co.**, of Charlotte. In San Francisco, **MacDonald & Kahn**, of San Francisco, bid in for $444,444 the Richmond sewer tunnel. **Frazier-Davis Construction Co.** was successful with a bid of $1,031,561 for two sections of Buffalo, N. Y.'s new sewer system. In St. Paul, Minn., **Barnett & Record Co.**, of that city, bid $721,207 for sewage settling tanks.

Miscellaneous

Another Sixth Ave. subway contract in New York City, from 27th to 33rd Sts., was let to **Carleton Co. Inc.**, of New York, for $6,392,879. Airport improvements at Baltimore, Md., are being handled under a $1,332,960 contract with the **Arundel Corp.**, of Baltimore. Railroad relocation in Muskingum watershed of Ohio is being started by **Ferguson & Edmondson Co.**, of Pittsburgh, under a $527,940 contract.

Project Progress Notes

Parker Dam — On Oct. 22 crews of **Six Companies Inc.**, under direction of Frank Crowe, who was construction superintendent at Boulder dam, diverted Colorado River from its course into two 29-ft. diversion tunnels bypassing site of dam. Dam is being built by U. S. Bureau of Reclamation as integral part of Colorado River aqueduct in Southern California.

Grand Coulee Dam — On Columbia River in Washington, **Mason-Walsh-Atkinson-Kier Co.**, of Mason City, Wash., began river diversion Oct. 7 by placing first 275-ton unit of 85-ft. cross river crib.

CURRENT JOBS

...and Who's Doing Them

CONSTRUCTION—
A Cooperative Industry

EVERY CONSTRUCTION enterprise is a cooperative effort, and therein construction differs radically from most manufacturing and service industries. The manufacturer, within his own organization, researches his market and materials, designs his product, fabricates it and merchandises it through his own outlets or his dealers. The service utility organizes its service and offers it in more or less conventional form. In both cases the producer offers his product for what it is, at a price, and the user takes it or leaves it.

But the construction project is not handled so simply. In the beginning the owner, whether a private individual, a business house, a utility or a public agency, must determine that it needs a certain facility. Its engineers, either staff or retained consultants, make the requisite studies and design the appropriate structures. If these involve permanent operating equipment, the manufacturer of that equipment may put his engineers to work on its design and application. In some cases the owner's engineers may call in qualified contractors to advise concerning the possible influence of construction procedure on the design.

Once plans are drawn and specifications written they may be turned over to the owner's construction department or, as is more usual, submitted to contractors for competitive bids. The invitation for these bids may offer alternative designs or may open the door for the bidders to submit alternatives.

THE GENERAL contractors then may seek bids on sections of the project from subcontractors or from the manufacturers of permanent equipment. They may consult with the manufacturers or distributors of construction equipment as to the most efficient methods and plant to do the job. They get prices from materials producers or dealers.

Even after a contract is awarded many owners and their engineers are receptive to suggestions offered by a contractor to improve the design. In some cases actual conditions, as revealed during construction, may necessitate a revision of design and in this the contractor may have a substantial influence.

At every stage, therefore, a construction project is open to the influence of the owner, his engineers, the contractor, the subcontractors, the manufacturers of permanent or construction equipment and any of those who have a hand in it. When it is completed it represents a kind of cooperative effort that is quite in contrast with that involved in manufacturing. In the factory many may work on a project but few have a voice in its design or fabrication.

All this gives rise to certain conditions that are characteristic of the construction industry. One of the most important of these is the long period of formulation during which a project is exposed to the consideration of many minds. Of course the ultimate authority for decisions must rest with the owner or his representative, but new ideas may originate anywhere along the line; and once they have originated they must run the gauntlet of many responsible minds before they surely will be embodied in the finished structure.

SUCH CONDITIONS help to make construction a fertile field for new ideas, new methods, new materials and new equipment. Somewhere along the line the proponent of what is new usually can get a hearing; somewhere, if his offering really is worth while, he will find an attentive ear.

But, as always, the increased opportunities involve increased effort. Just as this set-up offers many points of entry for new ideas so it offers many points of possible obstruction. The man with the idea must, therefore, keep it constantly before all those who may have a voice in its survival. Some may recommend, some may specify, some actually may purchase and some may have no more than the negative influence that we call "nuisance value," but all of them are potential factors in a decision.

Other circumstances help to make construction one of the most open and flexible of the industries but this cooperative factor is of major importance. Construction procedure opens many doors to new ideas but it demands exceptional vigilance and alertness if those ideas are to stick.

Willard Chevalier

CONSTRUCTION METHODS, November 1936, Volume 18, Number 11. Published Monthly, price 20¢ a copy. Subscription rates—United States, Canada, Mexico and Central and South American countries, $2.00 a year. All other countries, $4.00 a year or 16 shillings. Entered as second class matter October, 1926, at Post Office at New York, N. Y., under the act of March 3rd, 1879. Printed in U.S.A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Contents Copyrighted 1936 by McGraw-Hill Publishing Co. Inc., 330 West 42nd Street, New York, N. Y.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42nd St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

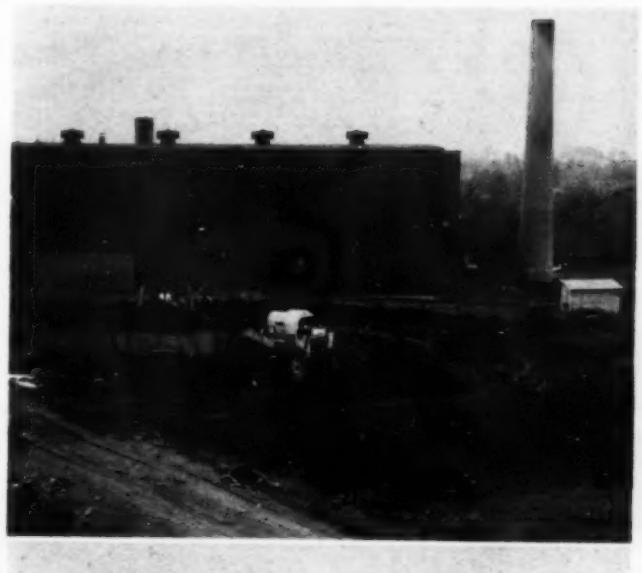
JAMES H. McGRAW, JR., Chairman — MALCOLM MUIR, President — JAMES H. McGRAW, Honorary Chairman — WILLARD CHEVALIER, Vice-President — B. R. PUTNAM, Treasurer — D. C. McGRAW, Secretary

In Earth Moving and Industrial Material Handling

DROP

YARDAGE and TONNAGE COSTS WITH

TRAC-TRUKS



Three years of successful service in the earth moving field prove that Trac-Truks are efficient, low cost hauling units . . . units that meet the ever increasing demand for greater hauling economy in both the earth moving and industrial fields. Trac-Truk flexibility is the answer. Varying power factors are available to produce the type of performance required; tire sizes are adaptable to provide most effective flotation of heavy loads; body design and capacities meet the need of diversified material and hauling conditions. The unique Patented Euclid Wheel Wind solves the dumping problem completely in being the simplest, smoothest and most trouble-free of all door operating devices. Use of Trac-Truks in the chemical and quarry field is illustrated to the left. Euclid engineers can show you how hauling costs can be lowered on your operations. Call us in!

EUCLID
THE PIONEER

THE EUCLID ROAD MACHINERY CO.

CLEVELAND, OHIO U. S. A.

BRANCH OFFICES: 301 SO. BROAD STREET, MEMPHIS, TENN. • 210 FOURTH STREET, ROANOKE, VA.

World's Largest Lift Span

AT TRIBOROUGH BRIDGE

Kept Level by G-E Selsyn System, Lifted and Lowered by G-E Motors

Harlem crossing of the new Triborough Bridge System, Taylor-Fichter Steel Construction Co., Inc., General Contractors

IN less than two minutes the world's largest lift span, at the Harlem River crossing of the new Triborough Bridge (New York City), can be raised or lowered through the 80-foot travel limits.

Level is maintained by G-E Selsyn control—G-E 200-hp hoist motors are synchronized electrically to keep the span level at all times. This system, simple to operate and time-saving in construction and operation, was developed and has been applied successfully by General Electric to this great new bridge and to half-a-dozen other outstanding bridges, including the world's *longest railway lift bridge,* at Buzzards Bay, Mass.

THE TRIBOROUGH LIFT SPAN	
Roadway area	20,000 sq ft
Length	310 ft
Weight	2,050 tons
Lift	80 ft
Time	1¾ min
Motors	6 G-E 200 hp

G-E motors and G-E Thrustor operated brakes in a control tower assure dependable, smooth operation

Whatever your construction requirements, let G-E engineers advise you on the use of new electric equipment which will be most profitable to you. General Electric, Schenectady, N. Y.

YOU GET SPEED FOR THE JOB, MORE SERVICE FOR YOUR MONEY, WHEN YOU BUY G-E EQUIPMENT

020-295 A

GENERAL ELECTRIC

'Incor' Halves Heating and Protection Costs

TEN YEARS' EXPERIENCE PROVES COLD-WEATHER ADVANTAGES OF 'INCOR'

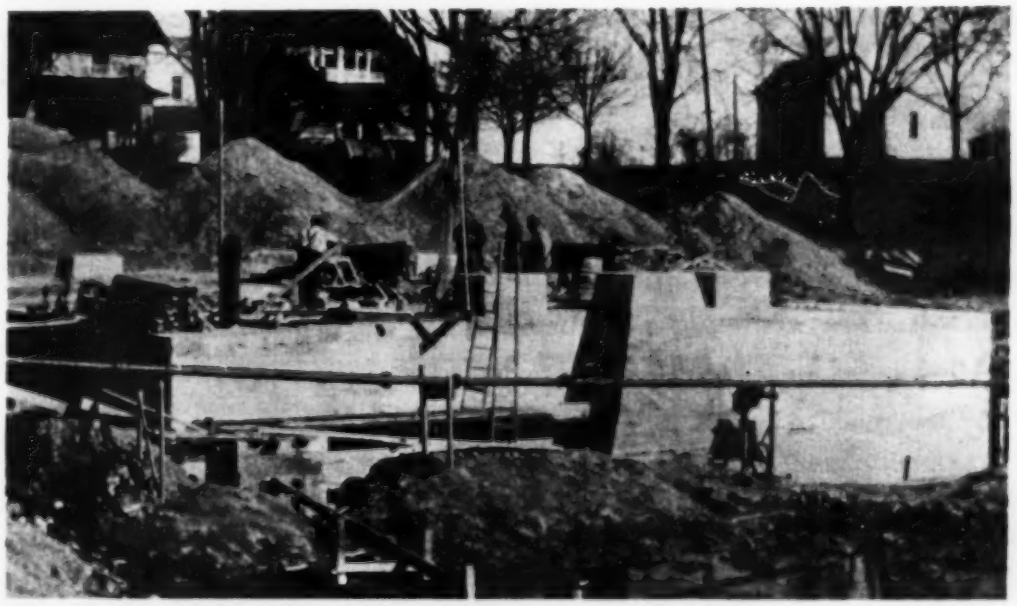
JANUARY temperatures were well below freezing when work began on the 250,000-gal. reservoir at Clyde, Ohio (below). To wait for Spring meant the reservoir wouldn't be ready when needed. Exterior and partition walls and floor work had to proceed. With outside temperatures often down to zero, ordinary cement meant expensive heat-protection. 'Incor', used for all work concreted in January, February and March, cut heating and protection costs in half—and at the same time produced the high-quality, watertight concrete needed for jobs of this kind.

'Incor's dependable high early strength does away with long, costly winter curing delays. You simply heat 'Incor' concrete (60° to 80°, according to conditions), retain this heat for 48 hours, and the concrete is service strong, safe from freezing danger. Resulting economies widen the range of winter work. Unfinished projects can be readily closed out; work normally put over until Spring, can now be carried forward, at a distinct saving.

Write for "Winter Book"

Why not estimate these savings and see for yourself what it means to use a better Portland cement which cures thoroughly in a fraction of the usual time. Write now for free copy of a practical book entitled "Winter Construction," summarizing ten years' experience with 'Incor'* in cold-weather concreting. Address Lone Star Cement Corporation, Room 2203, 342 Madison Avenue, New York. Sales offices in principal cities.

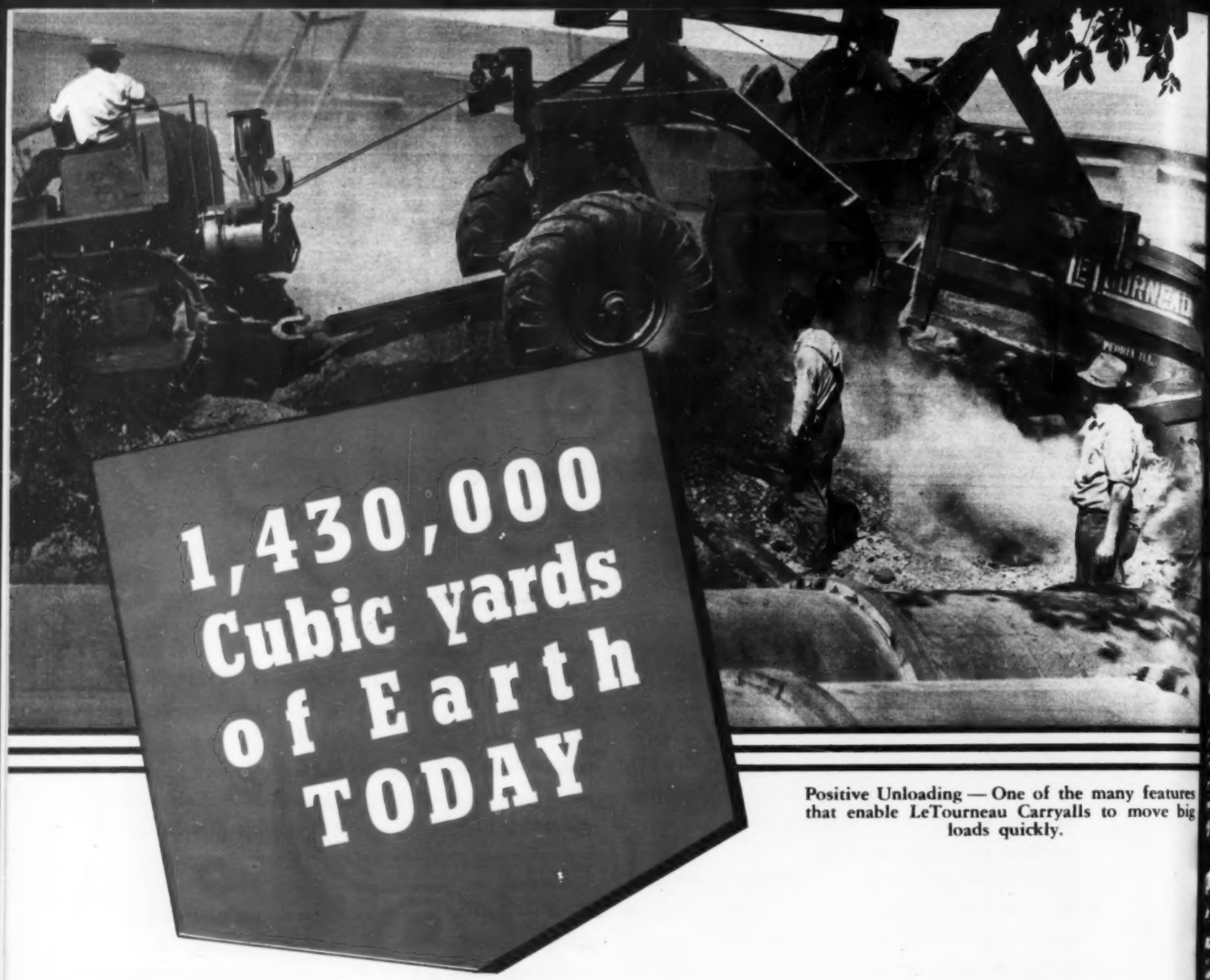
*Reg. U. S. Pat. Off.



* * *

'Incor' halved the cost of heat-protection in constructing this 250,000-gal. reservoir at Clyde, Ohio—and at the same time produced the high-quality, bone-dry concrete needed for exposed structures. Why not figure the savings made possible with 'Incor' on work now in progress or about to start. You'll find it pays — and pays well.

'INCOR' 24-HOUR CEMENT



Positive Unloading — One of the many features that enable LeTourneau Carryalls to move big loads quickly.

Ahead of the LeTourneau Carryall Scraper that rolls out of the factory and onto the job today are 1,300 other LeTourneau Carryall Scrapers, enough to move 1,430,000 cubic yards* of earth and rock in a 22-hour day. And there are enough other LeTourneau units — Angledozers, Bulldozers, Buggies and Rooters — to double that figure. Nearly 3,000,000 cubic yards of excavation in a single day!

This job-proved equipment, working day in and day out the world over, in mud, snow, sand and rock, in blistering heat and subzero cold, has demonstrated that LeTourneau's stout construction keeps equipment going with a minimum of lost time, that LeTourneau's fast-acting cable control gives split-second control regardless of weather conditions, that LeTourneau equipment can and does move big loads easily, quickly and cheaply. See for yourself what LeTourneau equipment can do. Watch it work, time its speed, measure its loads, compare it with competitive tools, then figure out for yourself how LeTourneau job-proved equipment will cut your costs.

R.G. LETOURNEAU INC

PEORIA, ILL., STOCKTON, CALIFORNIA

Cable address: "Bobletorno."

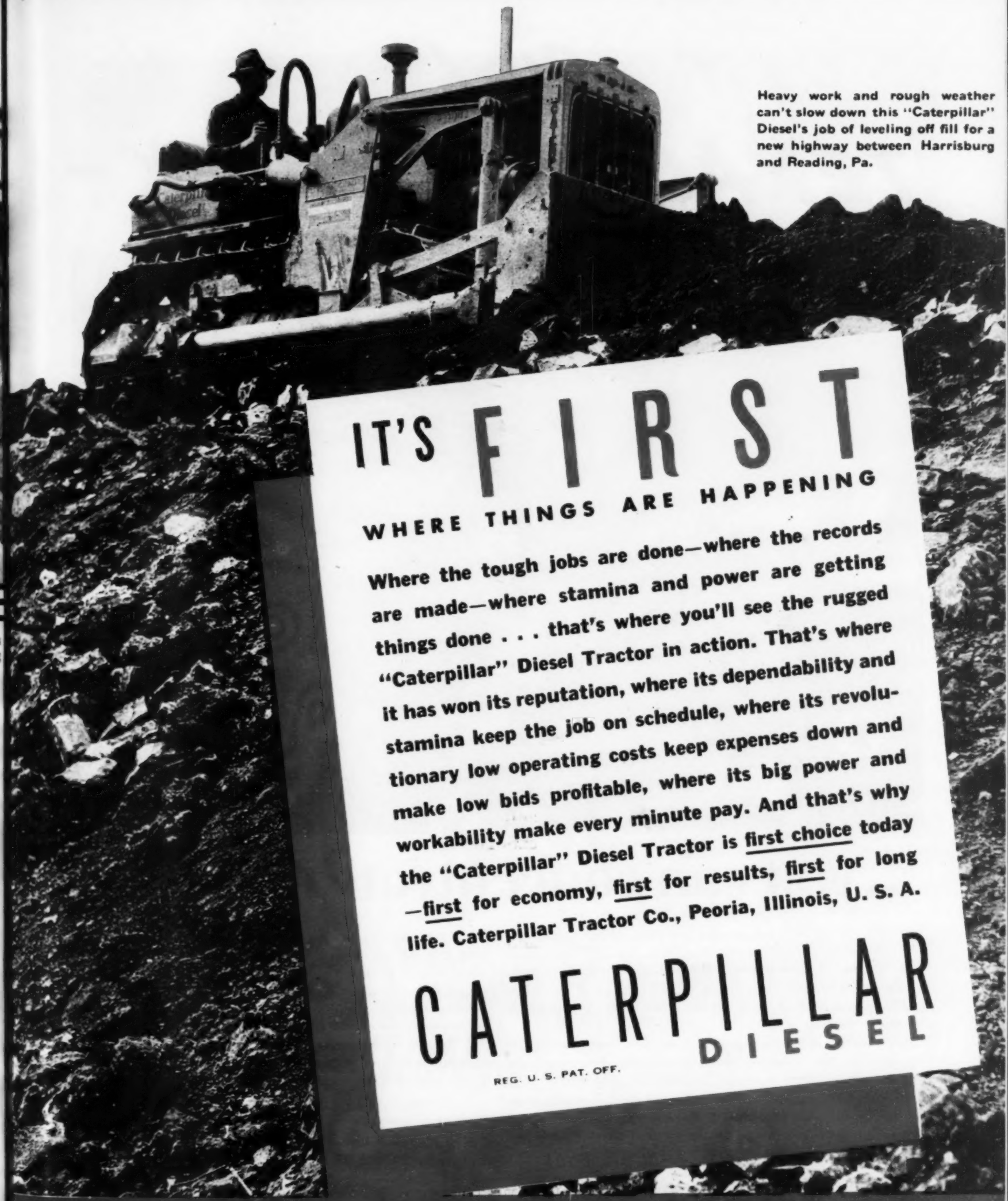
Manufacturers of: **ANGLEDOZERS*, BUGGIES*, BULLDOZERS, CARRYALL* SCRAPERS, CRANES, DRAG SCRAPERS, POWER CONTROL UNITS, ROOTERS*, SEMI-TRAILERS.**

Sold by Caterpillar tractor dealers everywhere.

*Name registered U. S. Patent Office.

**Figured on a very conservative average of 50 pay yards hourly on a 1,000-foot one-way haul.*

LETOURNEAU *Job Proved* EQUIPMENT



Heavy work and rough weather can't slow down this "Caterpillar" Diesel's job of leveling off fill for a new highway between Harrisburg and Reading, Pa.

IT'S FIRST

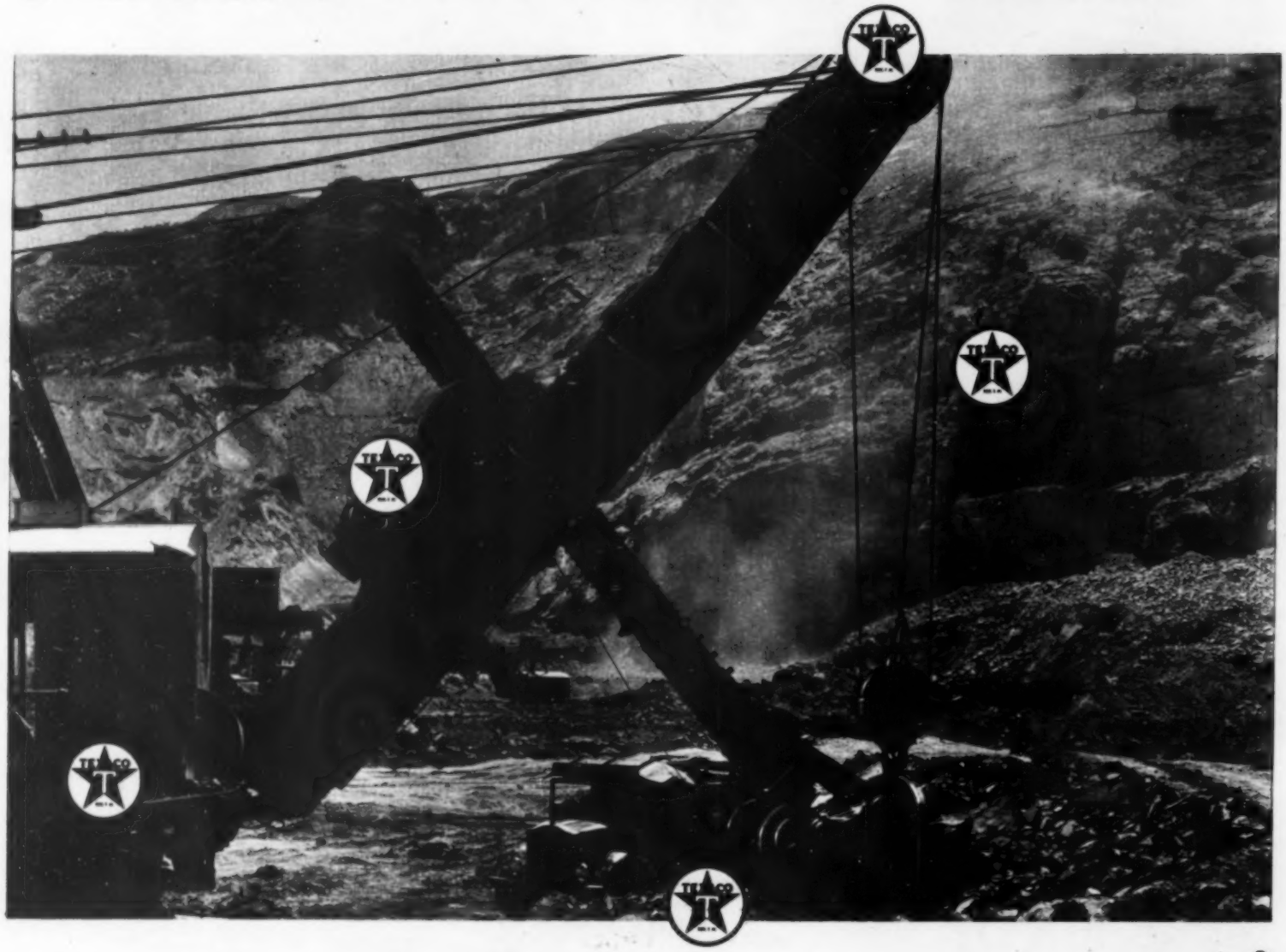
WHERE THINGS ARE HAPPENING

Where the tough jobs are done—where the records are made—where stamina and power are getting things done . . . that's where you'll see the rugged "Caterpillar" Diesel Tractor in action. That's where it has won its reputation, where its dependability and stamina keep the job on schedule, where its revolutionary low operating costs keep expenses down and make low bids profitable, where its big power and workability make every minute pay. And that's why the "Caterpillar" Diesel Tractor is first choice today —first for economy, first for results, first for long life. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR DIESEL

REG. U. S. PAT. OFF.

With
TEXACO AT WORK—



. . . you can concentrate on yours!

WHENEVER you see a job running smoothly, there's another important job going on at the same time . . . a LUBRICATION job. You can pass the responsibility for this second job on to us . . . to your advantage.

Texaco is at work in the contracting, and every other industry under the sun.

Daily reports—made by engineers—from the plants using Texaco Products give us a constant check-up on their performance and enable us to meet new operating conditions as soon as they arise.

Periodic consultations with the makers of your machinery show us the trends in machine design. We are constantly developing lubricants that enable you to get the greatest efficiency from this machinery. Texaco Crater is one result of this constant development.

When you use Texaco Crater on fast-running wire rope, even when it is exposed to all kinds of weather, it encloses each individual wire in a tough, viscous coating that clings.

Used in gear trains, CRATER spreads itself from gear to gear, quieting the noise, stopping undue wear. It successfully lubricates the chains, sprockets and treads of crawlers.

A Texaco representative will be glad to provide practical engineering service to prove the economies of Texaco Products.

THE TEXAS COMPANY
135 East 42nd Street • New York City

Nation-wide distribution facilities assure prompt delivery

TEXACO *Industrial Lubricants*

VISIT THE TEXACO EXHIBIT—POWER SHOW—GRAND CENTRAL PALACE, N.Y., NOV. 30th to DEC. 5th—BOOTH 282

LONG ROPE LIFE

IN SPITE OF FREQUENT CRUSHINGS

Select the Rope that Fits Your Job

Every application of wire rope has its own greatest destructive force. In order to enjoy long rope life it must be overcome by proper selection of construction. Take the unavoidable haphazard overwinding as an example. This subjects the rope to undue crushing and, unless the rope is designed to withstand it, will flatten the rope and cause early failure through unequal distribution of the load on the several strands. When overwinding prevails, select a rope with a wire rope core. It will last longer. Other suggestions, helpful in the selection of wire rope for specific purposes, will be gladly given. Write today and tell us your use of wire rope.

•

WICKWIRE SPENCER STEEL COMPANY, *General Offices:* 41 East 42nd Street, New York. *Sales Offices and Warehouses:* Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles; *Export Sales Dept.:* New York. WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

WIRE ROPE
by Wickwire Spencer

WICKWIRE SPENCER STEEL CO.
41 East 42nd St., New York City
Please send me your new Rope Manual that tells how to make wire rope last longer.

Name_____

Firm_____

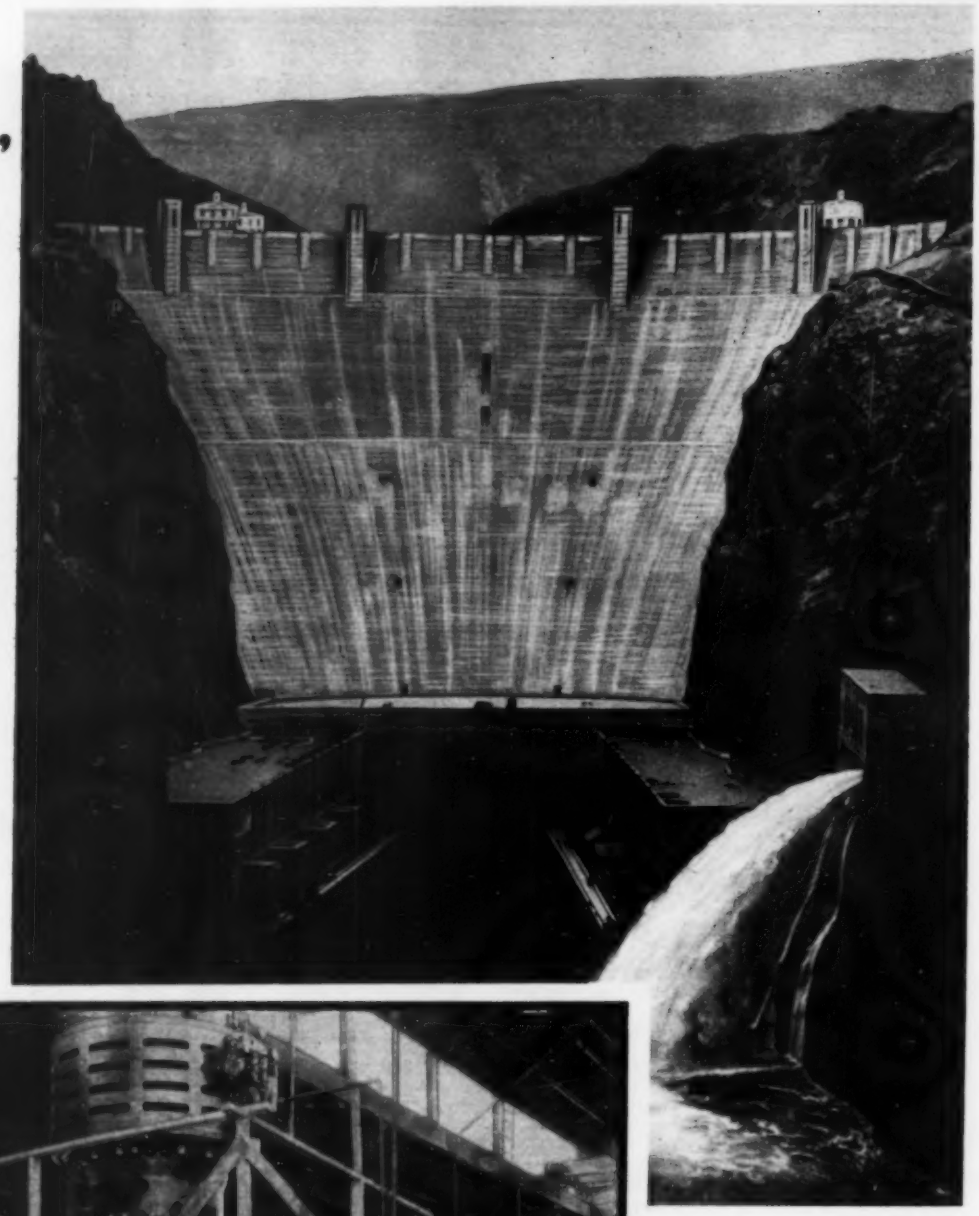
Address_____

City_____ State_____

400,000 POUNDS

—AND THEY CALL IT A "Butterfly"

That's the scale they do things on at Boulder Dam



OF COURSE, it's not just *size* that counts, when you're deciding what metal to use to carry out the design for a job like the butterfly valves at Boulder Dam. Every ounce of metal used had to have the stamina to withstand the onset of tons of water for a generation or longer.

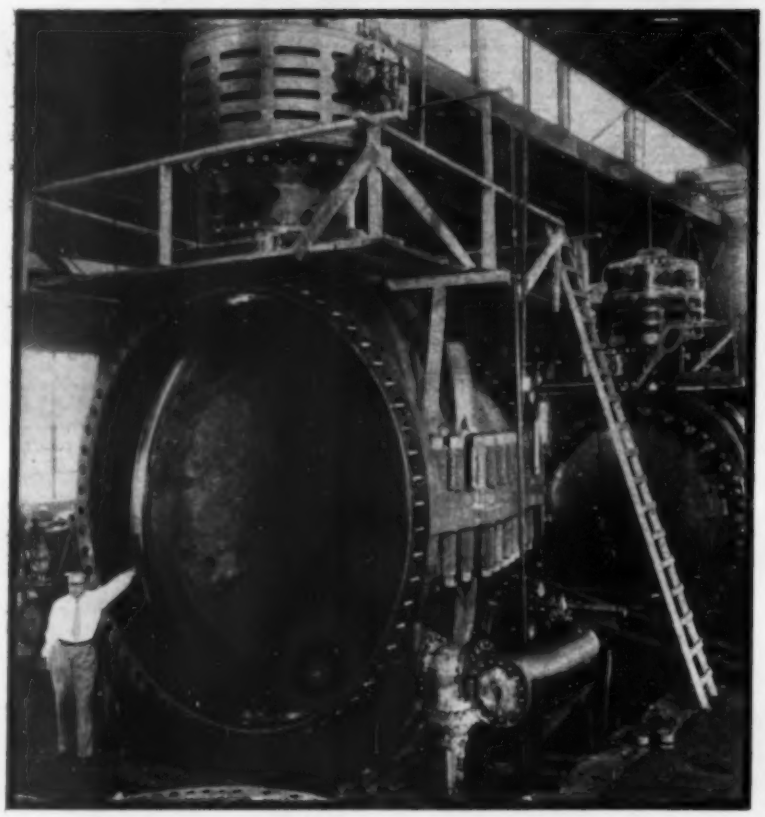
But size does matter—in more ways than one. It's more difficult to keep uniformity of grain texture, to hold the vital toughness, when your castings are 168 inches diameter, like this one. And think of the enormous cost of repairs and replacements . . . the engineers had to choose metals that would need none for years.

To assure these results, six 168-inch valves like this one were specified of a Nickel Alloy Steel, cast to this composition:

Carbon	0.25—0.35%
Manganese	1.00% max.
Silicon	0.40%
Nickel	1.00—1.50%

With this analysis, the valves show a minimum tensile strength of 75,000 p.s.i., and a yield point of 50,000 p.s.i.

Main holding bolts require somewhat different properties, which Boulder Dam's engineers supplied with S.A.E. 2340, a 3½% Nickel Steel. Let the Inco engineers apply their wide experience to help you find the best type of Nickel Alloy Steel to fit your particular needs.



● One of six 168-inch butterfly valves for Boulder Dam, weight 400,000 pounds. These were made by Hardie-Tynes Mfg. Co., with Nickel Steel Castings containing 1 to 1.50% Nickel supplied by the Erie Forge Co.

NICKEL ALLOY STEEL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

NORTHWEST

ANNOUNCES

A Complete line of TRUCK CRANES and TRUCK SHOVELS

FOR the first time the many exclusive advantages of Northwest crawler cranes and shovels have been made available to truck crane users in the Northwest Truck Crane and Truck Shovel.

The "feather-touch" clutch control insures ease of operation and increased output. Ball or Roller Bearings on *all* high speed shafts combined with a helical gear drive assure the transmission of maximum engine power and lowest maintenance costs. A worm gear boom hoist with positive control brings safety to booming operations. Cool running, non-grabbing cone swinging clutches, the cushion clutch in the hoist drum, a cast steel rotating base, split demountable lagging, coupled with Northwest's unusual simplicity of design, mean longer life and increased speed.

Don't buy a Truck Crane or Shovel until you have seen these Northwests!

GASOLINE • ELECTRIC • DIESEL • OIL

Built in a range of 15 SIZES ⅜ yd. capacity and Larger

Built by the NORTHWEST ENGINEERING CO.

The world's largest exclusive builders of gasoline, oil, diesel or electric powered shovels, cranes, draglines, pullshovels and skimmers

1728 Steger Bldg., 28 East Jackson Blvd., Chicago, Ill., U. S. A.

MAC O'MATIC AND HIS *Speed-o-Matic*

D—!#☆! IF I COULD ONLY FINISH THIS CUT TODAY I COULD GET IT IN THIS MONTH'S ESTIMATE! BUT D—!☆@—!!! IT'S IMPOSSIBLE!
IMPOSSIBLE, MY EYE! THE CHIEF FORGOT WE'RE STARTING WITH THIS NEW LINK-BELT POWER-CONTROL SHOVEL INSTEAD OF THAT LEVER TYPE MAN-KILLER!
'HANDLING THIS SPEED-O-MATIC SHOVEL IS AS EASY AS DRIVING MY "ROLLS-ROYCE" I'LL BREAK A RECORD TODAY WITHOUT BREAKING MY BACK!
LINK-BELT Speed-o-Matic
HEY, YOU FELLAS— GET MORE TRUCKS ROLLING IN HERE! THIS IS MOVING DAY!
WHERE THA HECK IS THAT HILL? IT WAS HERE THIS MORNING!
AT 5.30 P.M.
MAC O'MATIC! LET ME SMELL YOUR BREATH!
WHOOPEE! I PUT IN A RECORD-BREAKING DAY, BUT I'M NOT A BIT TIRED.
IT'S THE FIRST TIME POP EVER ACTED LIKE THIS!
SID HIX

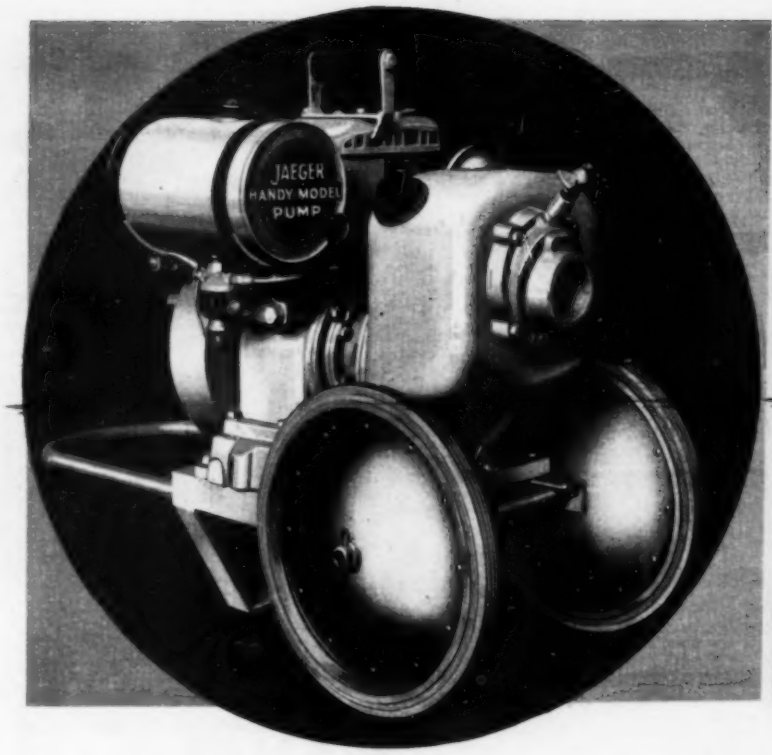
LINK-BELT *Speed-o-Matic*

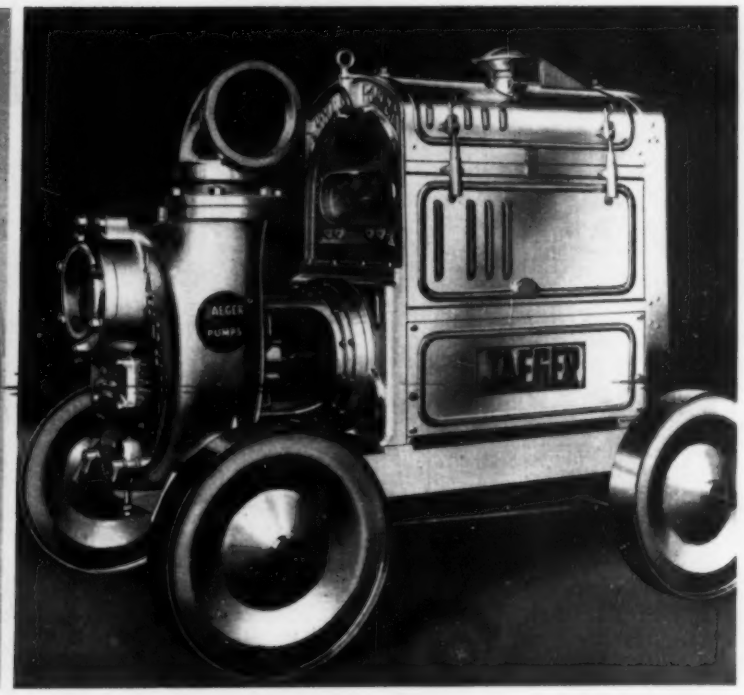
SHOVELS—DRAGLINES—CRANES

LINK-BELT COMPANY · 300 W. Pershing Road · CHICAGO

Offices and Distributors in Principal Cities

5853





7000 Gal. "HANDY" Pump — Get our new low price!

100 per cent automatic priming and built of castings 20 per cent steel thruout, with big 2½ H.P., 4-cycle engine, this compact, light weight "Handy Model" is the biggest pump bargain on the market.

PUMPS TO FIT ANY JOB

JAEGER "Sure Prime" PUMPS

Advanced Designs in SELF-PRIMING CENTRIFUGALS

Jaeger Heavy Duty "Sure Prime" Pumps are used today on largest construction jobs, industrial work, public utility and municipal maintenance and every other type of dewatering and supply service where huge capacity, fastest prime and lowest cost performance have made them world's biggest selling pumps of their type.

10,000 to 200,000 GALLONS CAPACITY

Built in 2", 3", 4", 6", 8" and 10" sizes, all of semi-steel with oversize power plants (gas or electric) to stand up under continuous heavy duty dewatering service and high pressures when used for jetting work. Will deliver thousands of hours of uninterrupted pumping where job requires.

JAEGER BANTAM WEIGHT PUMP

New, PORTABLE 7000 Gal. Pump

Most powerful, rugged, fastest priming and biggest capacity lightweight pump ever built — Aluminum and Alloy Steel construction, real 2½ H.P., 4-cycle engine — One man carries it — pumps anything from seepage to 7000 G.P.H.

WELL POINT SYSTEMS

From smallest sewer work to many of the biggest U. S. Mississippi River Locks, the huge air and water capacity of Jaeger "Sure Prime" Pumps, in combination with 2 to 3 times bigger capacity of Jaeger Continuous Slot Well Points, is providing "dry job" conditions for contractors at sensationally low costs. Auxiliary Air Pump doubles air capacity when needed on fast moving jobs. Send us your problem — no obligation.

Send for Our Complete New Pump Catalog

THE JAEGER MACHINE CO.
COLUMBUS, OHIO

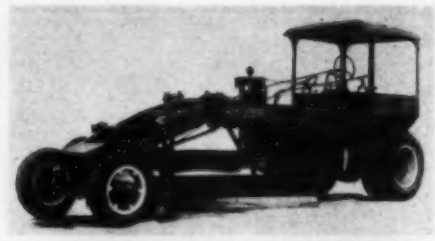
THE JAEGER MACHINE CO., 800 Dublin Ave., Columbus, O.
Send new PUMP CATALOG P-36 with special details on
☐ "Bantam Weight" Pump, ☐ 2", ☐ 3", ☐ 4", ☐ 6",
☐ 8", ☐ 10" Pumps ☐ Well Point Systems
Name .....
Address .....

When GALION Equipment goes to work—

COSTS DROP—
JOBS ARE SPEEDED

●As a normal consequence of constantly increasing traffic on our highways, highway construction is continually undergoing changes. . . both in design and in materials used. This progress (for there is no progress without change) has been watched by Galion. Alert to these new developments, Galion Road Machinery incorporates every best design feature to keep pace with your needs.

The Galion line is complete to meet every road building and maintenance requirement. Built-in quality goes beyond the outward appearance of Galion Units. Response to control lever movements is trigger-like. Dependability of performance under every operating condition has long been a recognized quality. Versatility, ruggedness and amazingly low maintenance costs are other desirable features well known to users of Galion Rollers, Motor Graders, Pull Type Graders, Maintainers, Planers, Spreaders, Sanders, Rooters, etc.



Standard Motor Grader: Powered by a McCormick-Deering I-30 Tractor Unit. All connections are welded to frame to form a single, solid unit. This rigid frame and bottom construction of Galion Graders is the secret of their smooth cutting and long life.

Junior Patrol Motor Grader: A light weight grader for general purposes. Meets the need for a light, inexpensive grader for work in townships, counties, cities and villages. Powered by a McCormick-Deering I-12 Industrial Power Unit. Only 6 to 8 gallons of fuel per day required.

Heavy Duty Motor Grader: Powered by McCormick-Deering model TD 40 Diesel Engine or by Case LI Industrial Tractor Unit. This massive powerful motor patrol Grader is capable of performing ANY duty to which it may be assigned. Wide axles give increased stability at all times. . . regardless of position of any wheel.

. . . SPEED UP ROAD MAINTENANCE . .

. . . SANDER FOR WINTER . . .

Write for literature covering the particular type of equipment in which you are interested.

The GALION IRON WORKS & MFG. CO.
GALION, OHIO
Distributors in Principal Cities

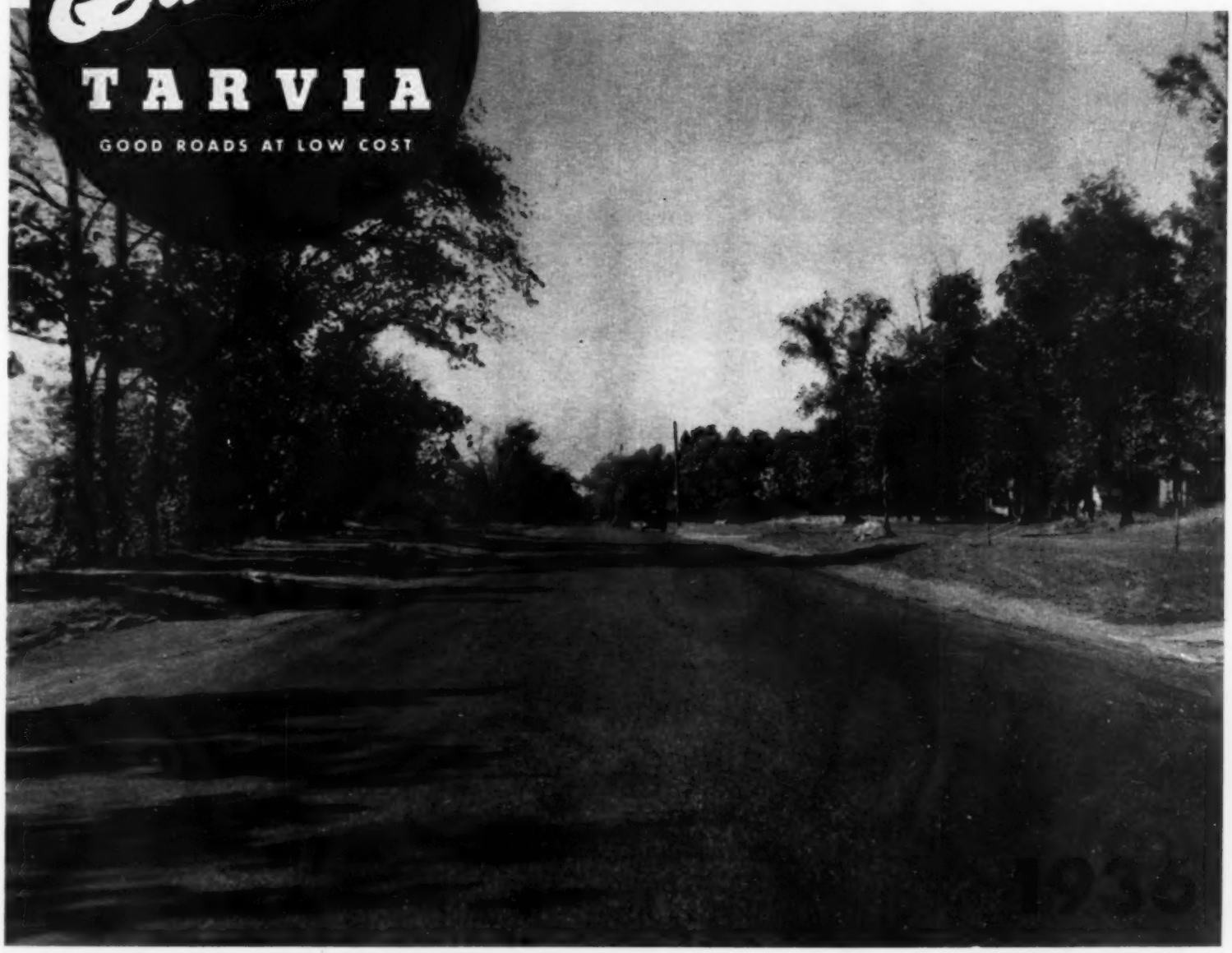
Highway Sander: Highway sanding of icy surfaces can now be done quickly and at low cost. This Galion Sander can be attached to any type of dump body truck. Drive is by means of friction from a standard automotive wheel which engages the distributing disc held in contact by means of a spring tension. Nothing to get out of order. Complete unit cleared of ground for towing when dump body is raised.

East River Boulevard, Minneapolis, Minnesota. Tarvia since 1910. One of the scores of Tarvia roads that have served Minneapolis continuously for twenty years or more.

Barrett

TARVIA

GOOD ROADS AT LOW COST



THE TECHNICAL SERVICE BUREAU of The Barrett Company invites your consultation with its technically trained staff, without cost or obligation. Address The Technical Service Bureau, The Barrett Company, 40 Rector Street, New York, N. Y.

East River Boulevard's twenty-six years of uninterrupted service is striking evidence that Tarvia roads "can take it." Hundreds of Tarvia roads built in the days when thirty miles an hour was reckless speeding are conclusive proof. They cost little to build and maintain, and are just as smooth, easy-riding and skid-safe today as they were when they were new. Let the Tarvia field man tell you about them.

THE BARRETT COMPANY New York Chicago Philadelphia Birmingham Boston St. Louis Cleveland Minneapolis Lebanon Milwaukee Detroit Baltimore Columbus Youngstown Toledo Buffalo Providence Syracuse Hartford Cincinnati Bethlehem Rochester Portland, Me. Norwood, N. Y. In Canada: THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver

General view of east end of pit at the Nevada Consolidated Copper Corporation, McGill, Nevada.

* The largest blast with Cordeau-Bickford of which we have record was made at Manistique, Michigan in 1932 and contained 4,000 holes!

in CONNECTION *with* Better Blasting–

In the great pit at Nevada Consolidated Copper Corporation, each blast is planned to loosen and break up the ore for easy removal. Holes, drilled 5′ to 7′ below grade, are sprung and the chambers loaded with powder. Ten sticks tied in a bundle are lowered by means of Cordeau to the center of the charge, and the hole is then tamped. As many as 60 holes, connected by lines of Cordeau along the surface, are fired at one time.*

In certain cases, when column loading is desirable to avoid back break, the charges are spaced at predetermined intervals throughout the length of the hole. Small bundles of stick powder are spaced at intervals and detonated by one length of Cordeau in the hole.

Thus Cordeau, the insensitive detonating fuse, simplifies loading, lessens hazard, increases the effectiveness of each charge by insuring proper detonation, and produces better blasting—easier removal.

Write for a free copy of the Cordeau Book.

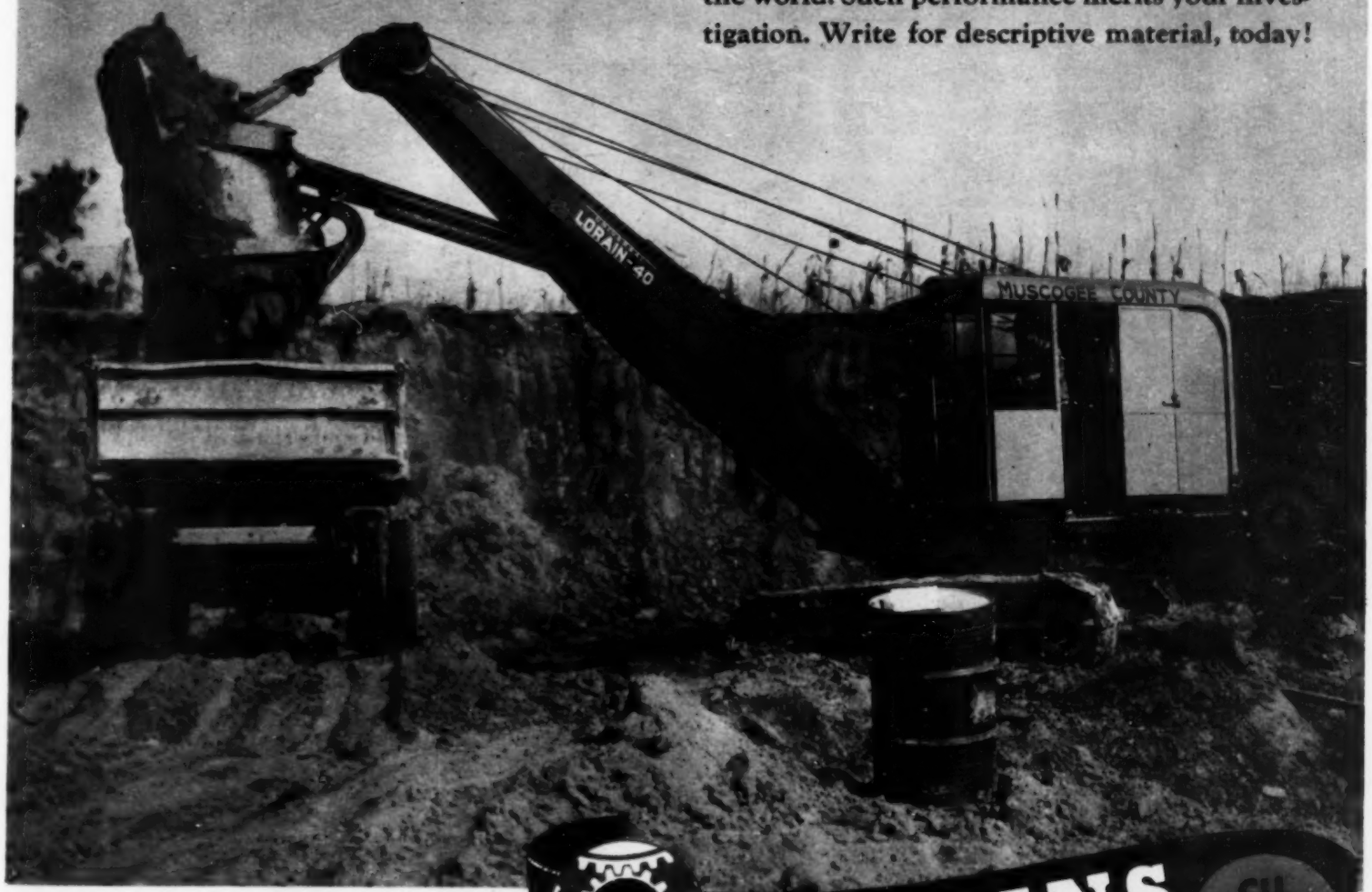
CB-34

The ENSIGN-BICKFORD COMPANY, Simsbury, Connecticut

SAFETY FUSE Since 1836 • CORDEAU-BICKFORD DETONATING FUSE

25 JOBS Show the 3/4 Yard Lorain-40 Averages 85 YDS. PER HR.

★ A survey of 25 L-40 jobs—18 shovels and 7 draglines, spread from Texas to Minnesota, from New York to California, covering all types of jobs and materials—shows these units move an average of 85 yds. per hour . . . The L-40 possesses the Speed, Power and Endurance to produce such yardage, yet in weight and price it approximates most ½ yd. units . . . Is it any wonder contractor acceptance has made the L-40 the fastest selling ¾ yd. machine in the world. Such performance merits your investigation. Write for descriptive material, today!



The UNIVERSAL CRANE CO., LORAIN, O.

THEW CENTER DRIVE

LORAINS

MOVE MORE MATERIAL, FASTER AT LOWER COST

CU. 3/8 to 2 YD.

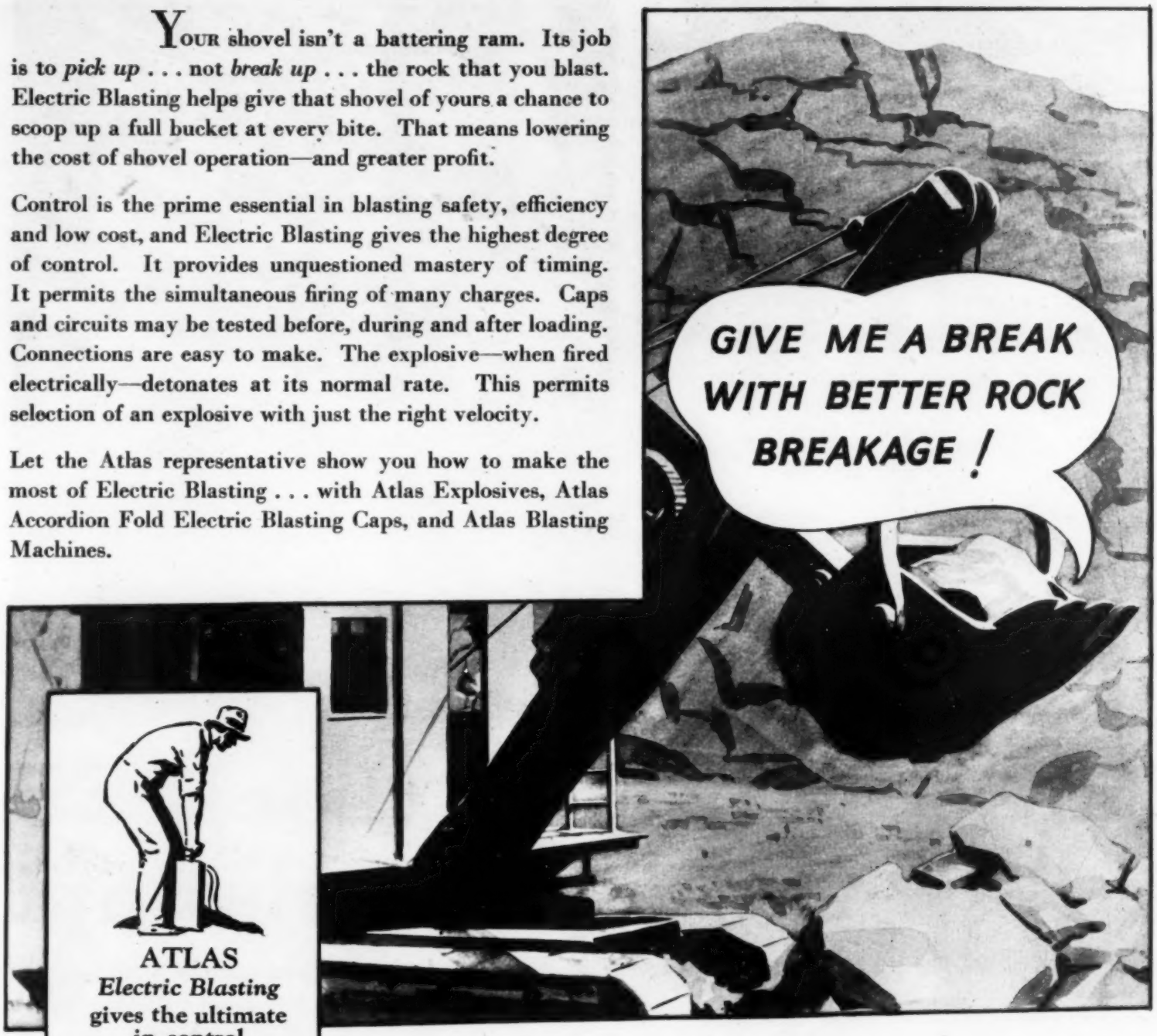
JAR
THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.
This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.
John A. Roebling's Sons Co., Trenton New Jersey
Roebling...
The pacemaker in wire rope development

If your shovel could talk...

YOUR shovel isn't a battering ram. Its job is to *pick up* . . . not *break up* . . . the rock that you blast. Electric Blasting helps give that shovel of yours a chance to scoop up a full bucket at every bite. That means lowering the cost of shovel operation—and greater profit.

Control is the prime essential in blasting safety, efficiency and low cost, and Electric Blasting gives the highest degree of control. It provides unquestioned mastery of timing. It permits the simultaneous firing of many charges. Caps and circuits may be tested before, during and after loading. Connections are easy to make. The explosive—when fired electrically—detonates at its normal rate. This permits selection of an explosive with just the right velocity.

Let the Atlas representative show you how to make the most of Electric Blasting . . . with Atlas Explosives, Atlas Accordion Fold Electric Blasting Caps, and Atlas Blasting Machines.



ATLAS
Electric Blasting
gives the ultimate
in control

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

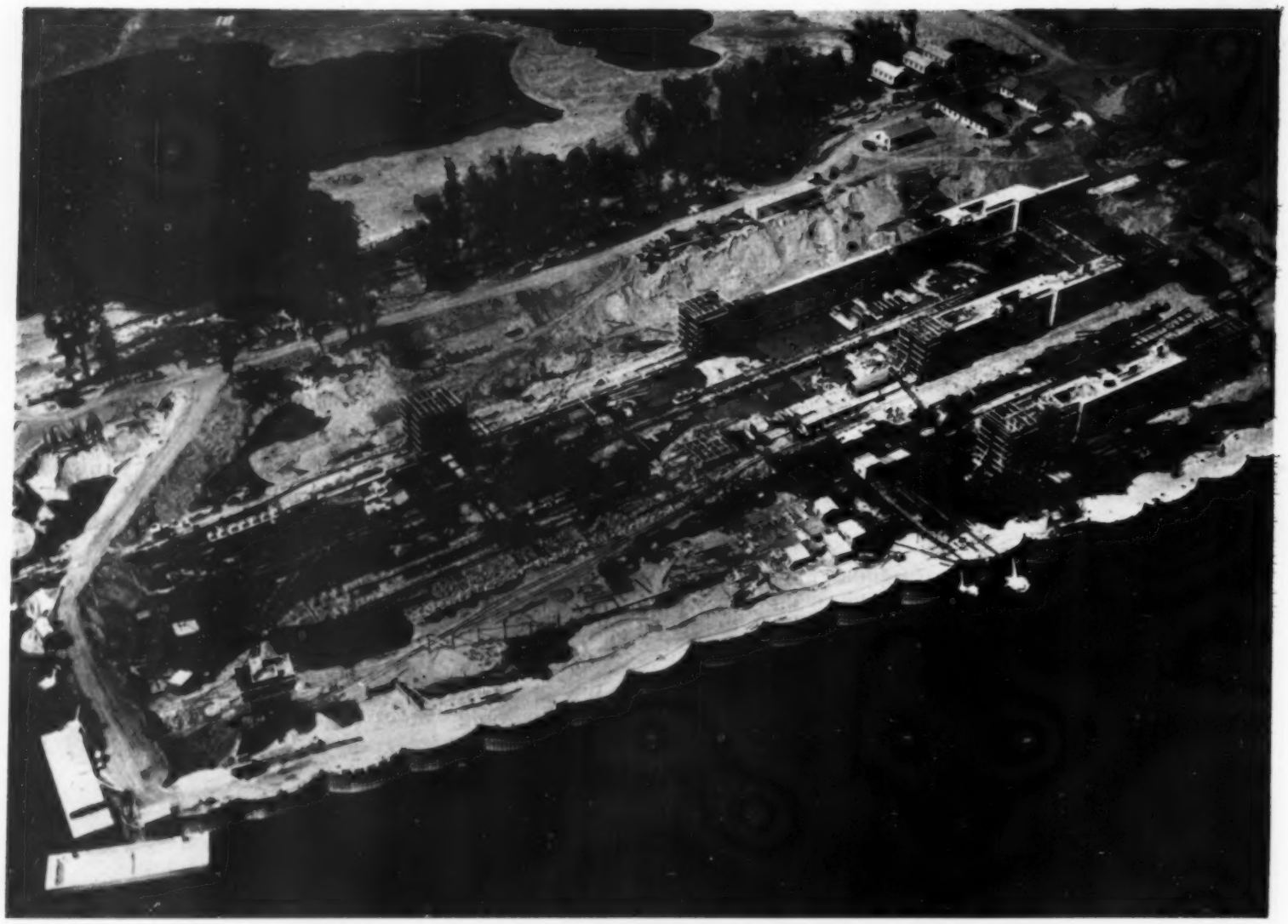
OFFICES

Allentown, Pa.	Joplin, Mo.	New Orleans, La.	Pittsburgh, Pa.	Spokane, Wash.
Boston, Mass.	Kansas City, Mo.	New York, N. Y.	Portland, Oregon	St. Louis, Mo.
Butte, Mont.	Knoxville, Tenn.	Philadelphia, Pa.	Salt Lake City, Utah	Tamaqua, Pa.
Denver, Colo.	Los Angeles, Calif.	Picher, Okla.	San Francisco, Calif.	Wilkes-Barre, Pa.
Houghton, Mich.	Memphis, Tenn.	Pittsburg, Kansas	Seattle, Wash.	

ATLAS

EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES



Inland Piling at Lock 25 On The Mississippi

Above: Construction photo of Mississippi Lock No. 25 at Cap Au Gris, Missouri. 1751 tons of Inland Section I-23 was used, some of the piles being 65 feet long.

This is the latest aerial photograph of the construction work underway on Lock No. 25 at Cap Au Gris on the Mississippi River.

The view clearly shows the neat tight job of Inland Steel Sheet Piling installed by the United Construction Co. United reports everything going well and work progressing splendidly.

This is but one of many successful Inland Piling jobs on the Mississippi. But Piling is only a part of the picture, for Inland Engineers work closely with the contractors from beginning to end, co-operating on design, method and construction until the job is completed.

We invite you to call an Inland Engineer on your next Piling or other construction job—for Inland Service will prove definitely helpful to you.

SHEETS • STRIP • TIN PLATE • BARS • PLATES • STRUCTURALS • PILING • BILLETS • RAILS • TRACK ACCESSORIES

INLAND STEEL CO.

General Offices: 38 South Dearborn Street, Chicago, Illinois

FLEET OPERATORS HAVE PROVED IT!

Just one of the many steps Gulf Scientists take to insure the high service value of *Gulfpride Oil*

An 8-cylinder automotive engine on the test dynamometer to determine the wear-life, horsepower output, carbon formation and friction losses due to differences in characteristics of motor oils.

OPERATING COST FIGURES prove that it's far cheaper to use *Gulfpride* . . the World's finest Motor Oil (100% Pure Pennsylvania)

Gulfpride is the only motor oil in the world refined by the "Alchlor Process." This famous process *literally* starts where others leave off. By removing the trouble-making impurities left in motor oil by less effective refining methods, the Alchlor Process produces an oil which has no equal.

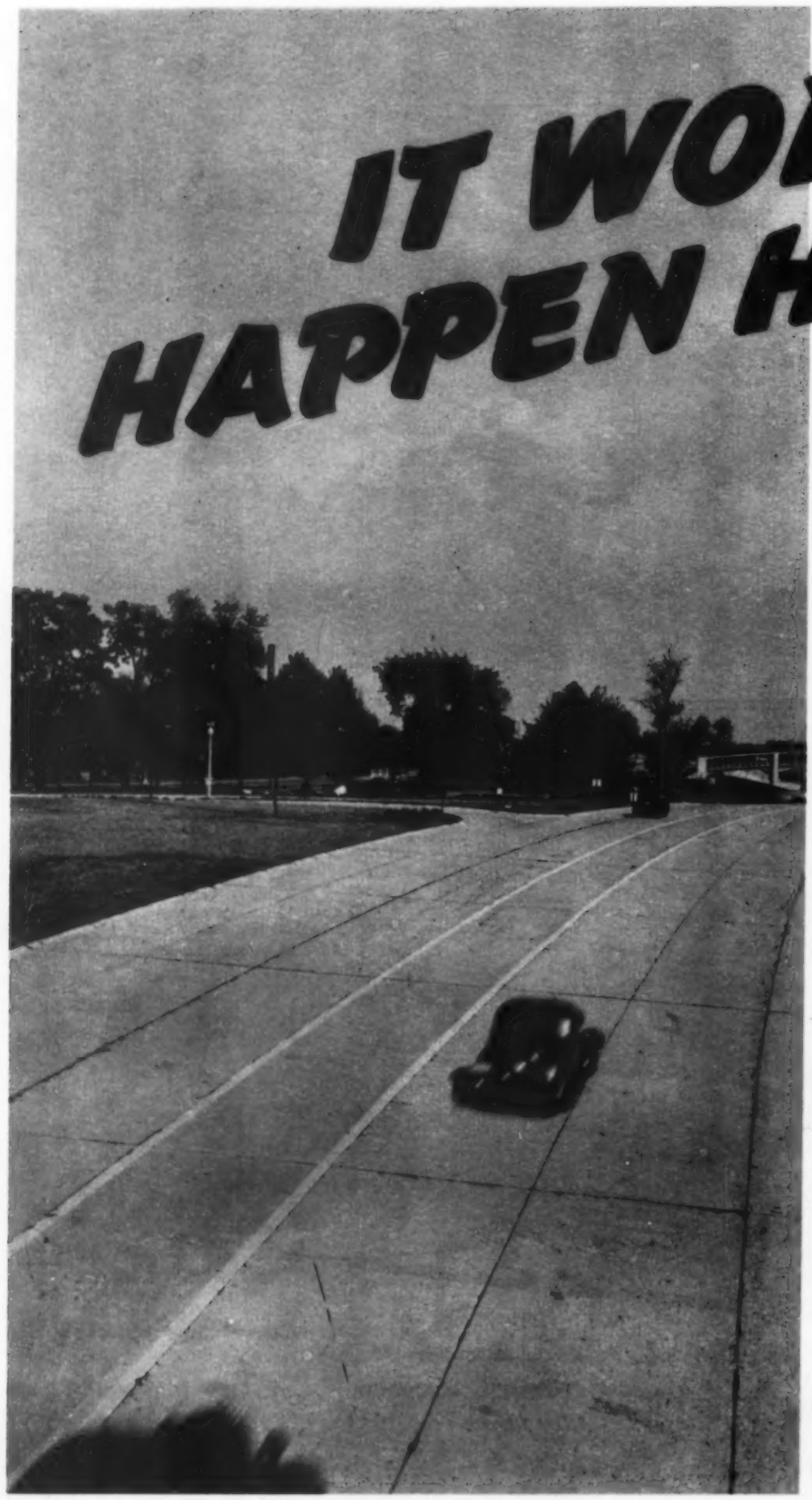
Trucks and commercial cars operate with far less expense when Gulfpride is used. Here is a typical statement—from a man in charge of a large fleet of trucks: "Our maintenance costs this year—with Gulfpride in service—have been less than half our former costs. We seldom need to add oil to any of our trucks between drains—which are less frequent than before. Gulfpride has *more than paid for itself* in our equipment."

You can afford to use Gulfpride Oil—because it costs less to use! More per gallon—but less per mile.

GULF OIL CORPORATION
GULF REFINING COMPANY

GULF

GENERAL OFFICES, GULF BUILDING, PITTSBURGH, PA.



IT WON'T HAPPEN HERE!

One million people seriously injured in *one year* through traffic accidents. That's what the 1936 record will show.

"It's got to stop!" people shout indignantly . . . and go right on cracking bones and fenders.

So—the only thing highway officials *can* do is to make streets and highways as safe as possible. They find that Atlas White Markers, shown in the picture at the left, help tremendously. For these easy-to-see markers act as safety guides. They keep drivers in their own lanes, out of the other fellow's territory.

Atlas White Markers are strips of hard, durable concrete built right into the street or road. They *stay* in and they *stay* white. Rain can't wash them away. Heaviest traffic can't wear them away.

No maintenance or repair expense

Do not confuse Atlas White Markers with the painted-on kind. Atlas White Markers are a permanent part of the pavement itself. Their life is for the life of the pavement. Once installed, you never have to give them another thought. There's no maintenance. No repair expense. No replacement expense.

That's why highway and safety officials find that Atlas White Markers, although higher in first cost, save money over temporary methods in the long run.

Helpbuild Safety into Streets and Highways with Atlas White Traffic Markers — Made with Atlas White Portland Cement—Plain and Waterproofed.

UNIVERSAL ATLAS CEMENT CO.
208 South La Salle Street, Chicago

United States Steel *Corporation Subsidiary*

M9

Safety Markers of Atlas White Portland Cement on Super-Highway through Forest Park, St. Louis, Mo. Constructed by Webb-Boone Paving Company, St. Louis, under plans and specifications prepared by Missouri State Highway Commission.

ATLAS WHITE PORTLAND CEMENT FOR TRAFFIC MARKERS

Established 1919
McGraw-Hill Publishing Company, Inc.

Construction Methods

ROBERT K. TOMLIN, Editor

Volume 18 Number 11.

November, 1936

23-TON UNIT comprising two 5x5-ft. drums mounted in individual oscillating frames and loaded with inundated sand compact heterogeneous quarry material in central section of rolled earthfill and rockfill dam.

CLOSE CONTROL *(in oval, left)* of moisture added to fill material by discharge from sprinkler trucks facilitates rolling to desired compaction giving minimum dry density of fines of 120 lb. per cubic foot.

Heavy Sheepsfoot Tampers

Compact Quarry Fill in San Gabriel Dam No. 1

TO CRUSH and compact quarry material ranging from fines to fragments passing a 6x9-in. grizzly in the central core of San Gabriel Dam No. 1, engineers of the Los Angeles County Flood Control District designed sheepsfoot tampers of unprecedented weight and flexibility. These rollers now are being used by the West Slope Construction Co., contractor for the dam. Each tamper unit is made up of two 5x5-ft. drums mounted individually in tilting frames which in turn are mounted in a rigid main frame. The tilting feature enables the rollers to maintain uniform contact with the rough surface of random fill material.

Unloaded, a tamper unit weighs about 14 ½ tons. To obtain greater weight the drums may be loaded with water, inundated sand or cast lead. At San Gabriel Dam No. 1 two units ordinarily are drawn in tandem behind an RD8 95-hp. diesel tractor. The forward unit is filled with inundated sand to give a weight of 4,500 lb. per linear foot of roller, and the rear unit is loaded with water to produce a weight of 3,500 lb. per linear foot of drum. Total weight of the two loaded units in tandem is about 45 tons. The tractor pulls them at speeds of 1.5 to 2.4 m.p.h.

Six passes with tandem units or twelve passes with a single unit ordinarily provide sufficient compaction, as compared with 20 to 24 passes by standard sheepsfoot tampers. A drum carries 108 feet 7 in. long spaced about 11¼ in. on centers. Each foot has a contact area of about 11 sq.in. Material is spread in 9-in. layers which are compacted to 6 in.

Roller bearings on which the drums turn are placed in tubes inside the drums, permitting a compact frame assembly that leaves no untamped path between the drums. Outer races for the roller bearings are bored in one operation, aligning the bearings without necessity of additional adjustments. Each bearing is protected by a dust seal and cover, and fittings are provided for pressure-gun greasing.

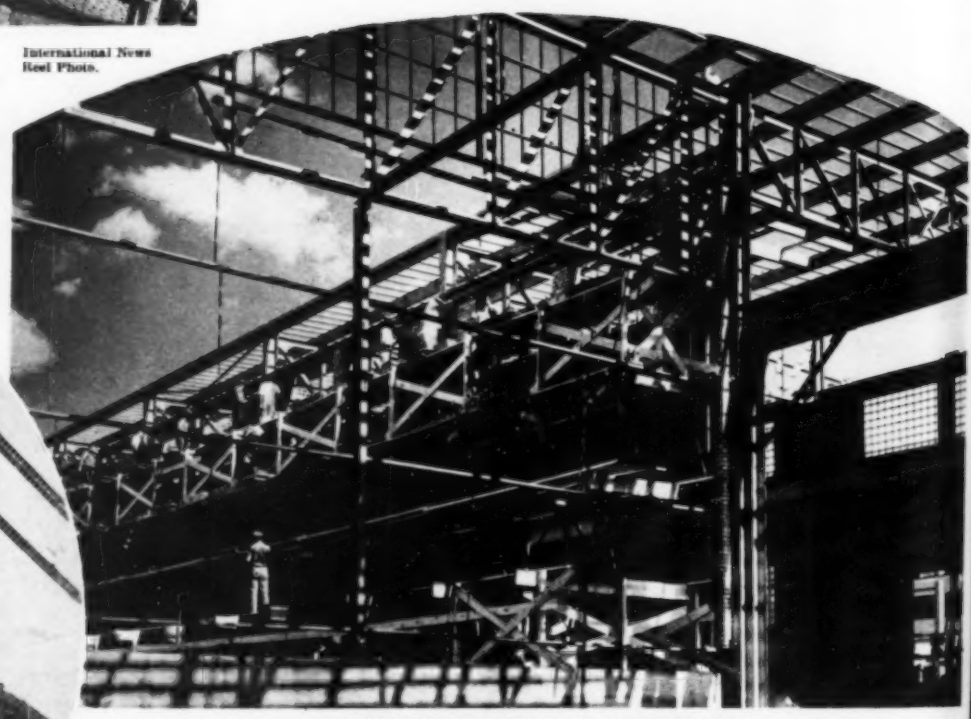
C. H. Howell is chief engineer of the Los Angeles County Flood Control District. The heavy tampers were designed under the direction of W. B. Ream, office engineer.

This Month's "NEWS REEL"

QUEENS MIDTOWN TUNNEL

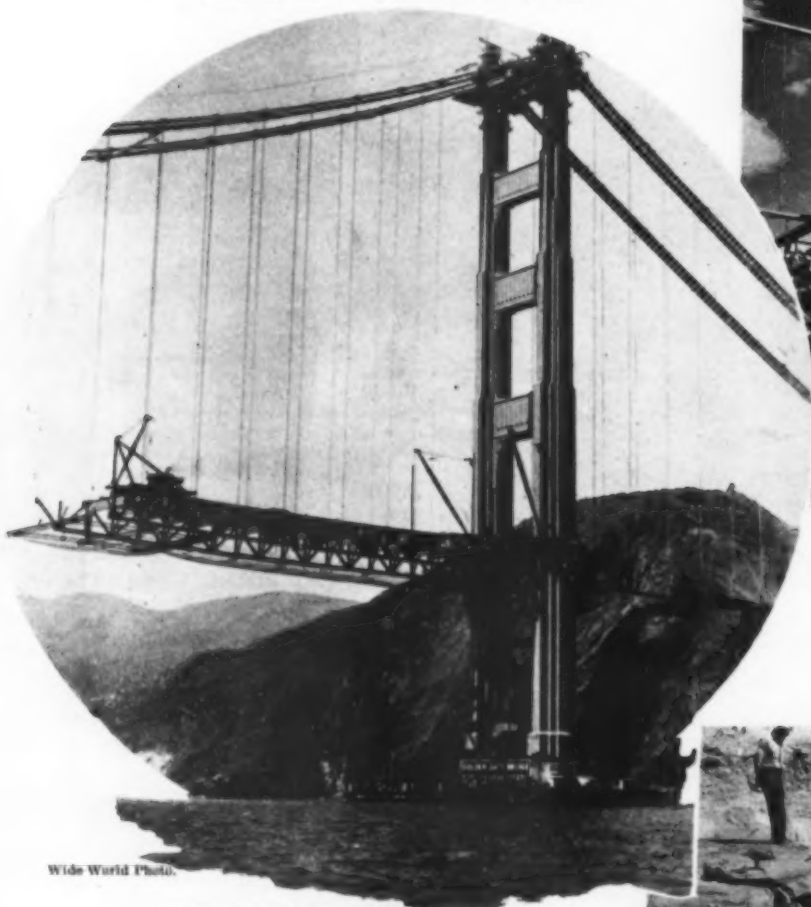
begins its race against time with excavation of first bucketful of earth at Queens shaft, on Long Island side of East River, when President Roosevelt presses button to start crane operation. Vehicular tube, financed by $11,235,000 grant and $47,130,000 loan from PWA, is to be completed in time to carry traffic between Manhattan and Long Island for New York World's Fair in 1939.

International News Reel Photo.



ACID-RESISTING MATERIALS

such as glass-block windows (to be seen above crane runway girder at right) are utilized by Austin Co., Cleveland, in building cleaning house of Republic Steel Corp.'s new wire mill on former marsh land in South Chicago. Use of 5,500 glass blocks eliminates steel sash which would be subject to destruction by corrosive acids employed in cleaning and pickling. Structural steel in cleaning house has minimum thickness of ⅜ in. Roof T's to support book tile over cleaning section may be discerned above brick wall of adjoining building under construction in left foreground.



Wide World Photo.

AS SUSPENDED STRUCTURE

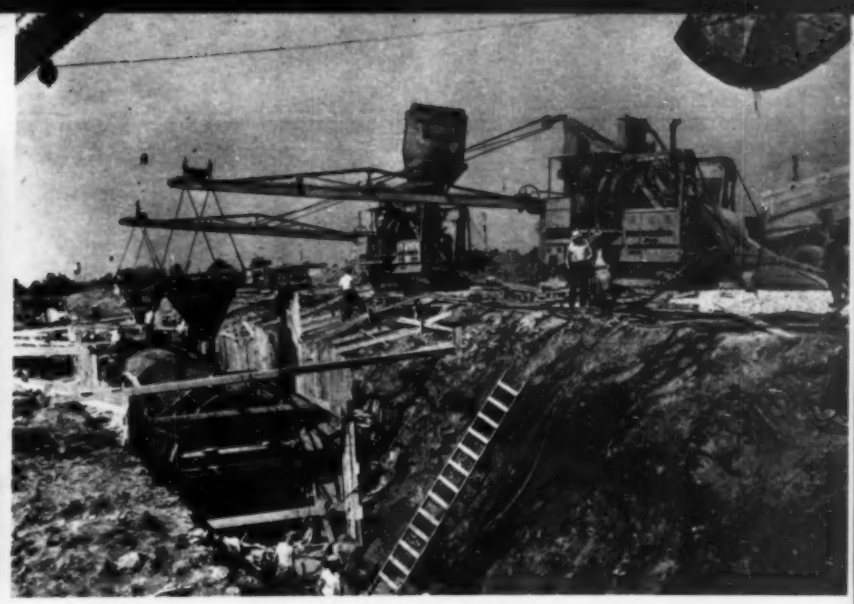
of Golden Gate bridge advances from towers to center of 4,200-ft. span, safety net hung beneath steel in 10-day period saves two carpenters from almost certain death, catching them after 35-ft. fall and preventing 220-ft. drop to water. Permanent sections of net remain in place under completed trusses; movable section is kept ahead of steel erection. Safety net gives workers greater confidence, enabling each derrick traveler to set more than 160 tons of steel per day.

CONCHAS DAM

on South Canadian River *(right)*, ¼ mi. below confluence with Conchas River, in New Mexico, passes through preliminary stage of construction with stripping of loose rock by U. S. Engineers with hired labor forces to reveal foundation and abutment conditions to prospective bidders. Excavation by U. S. forces was discontinued when contractor for main and wing dams, Bent Bros., Inc., and Griffith Co., took over work. Dam consists of concrete gravity main section about 220 ft. high and 1,160 ft. long, together with earth dikes on both sides having overall length of about 4 mi.

FIRST BUILDING DESIGN CONTRACT

for New York World's Fair 1939 is signed by Grover Whalen, president of Fair corporation. Harvey Stevenson, seated at left, signs for group of seven architects who were awarded contract to design administration building. Standing, left to right, are: Gerald A. Holmes, of Holmes & Thompson; Richard Arthur Kimball, of Kimball & Husted; Col. John P. Hogan, chief engineer of Fair corporation; Edgar I. Williams, architect; Richmond H. Shreve, member, Board of Design; W. Earle Andrews, general manager; Charles C. Green, secretary; Stephen F. Voorhees, chairman, Board of Design; Commander H. A. Flanigan, administrative assistant to president.



TWIN MIXERS

speed progress on Chicago sewer. Herlihy-Mid-Continent Co., contractor, operates two Koehring pavers in combination to concrete 3,800-ft. length of West Town outlet sewer in open cut in Hiawatha St., Stickney, in order to complete section this season for Sanitary District of Chicago. Tunnel work on sewer, which has total length of 11,000 ft., can proceed through cold weather. Open-cut sewer is of horseshoe section, 12 ft. 4½ in. by 14 ft. 9 in., heavily reinforced, resting on shaley clay. Construction requires 3⅓ cu.yd. of concrete per linear foot.

SAN GABRIEL DAM NO. 1

grows at rate of 30,000 cu.yd. of rockfill per day toward final embankment volume of 10,600,000 cu.yd. More than 4,500,000 cu.-yd. already has been placed in dam by West Slope Construction Co., contractor. From upstream sump in foreground water is pumped by one 150-hp. vertical deep well turbine pump for sluicing rockfill and wetting rolled fill. Water likewise is pumped from main downstream sump by two 400-hp. deep well turbines. Dam is being built by Los Angeles County Flood Control District.

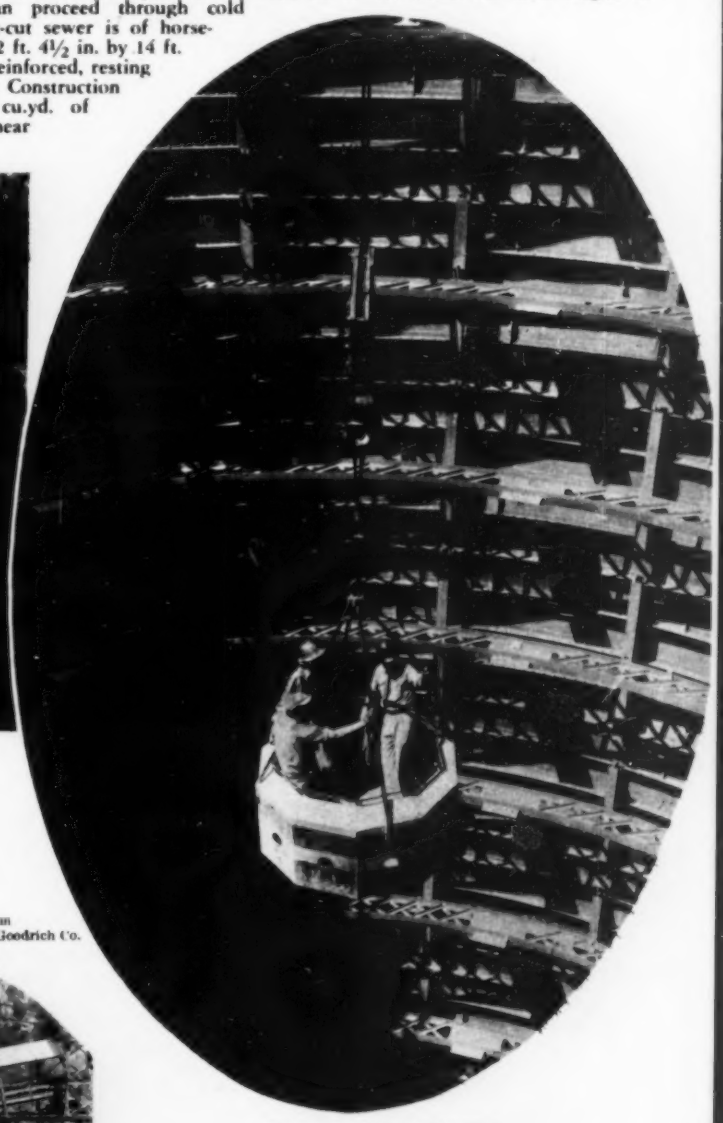
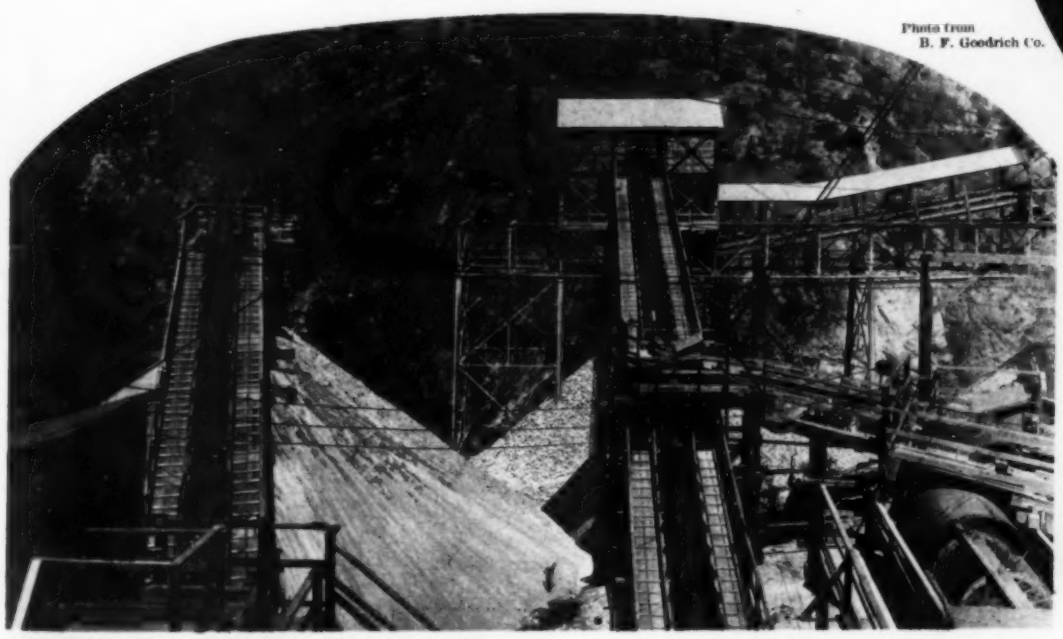


Photo from B. F. Goodrich Co.



CONTROL SHAFT

leading to diversion tunnel at Fort Peck dam on Missouri River in Eastern Montana provides elevator service for workmen riding skip on crane hoist line. Shaft is lined with steel plates backed by I-section studs and truss rings. Main control shaft for each of four diversion tunnels is 50 ft. in diameter and 260 ft. deep.

O'SHAUGHNESSY DAM

aggregates plant *(left)* erected by Transbay Construction Co., contractor, to add 80 ft. to structure, increasing total height to 430 ft., will supply 375,000 cu.yd. of materials for 275,000 cu.yd. of concrete going into this enlargement of San Francisco's Hetch Hetchy water project, expanding reservoir capacity from 206,000 to 360,000 acre-ft. at cost of about $3,200,000. Inter-connecting system of conveyors carries continuous stream of aggregates from primary crusher through screens and secondary crushers to stockpiles.

Pneumatic-Tired and Track-Mounted

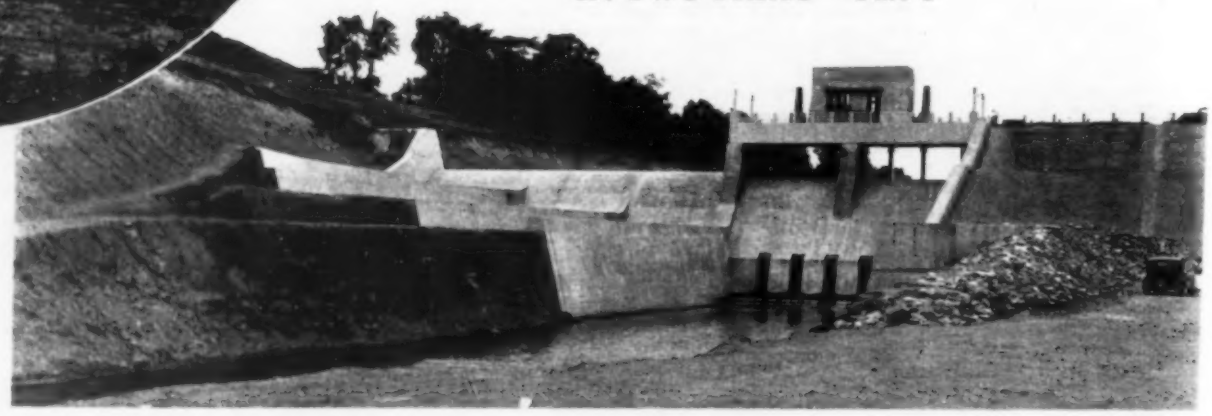
Earth Movers

Haul Materials for Rolled

Earthfill Dams

At 13 Muskingum Valley Reservoirs

IN TWO PARTS — *Part 1*



CHARLES MILL DAM, one of first projects completed, has rolled earth embankment 1,400 ft. long and 50 ft. high *(in circle, above)* with rockfill and riprap on upstream face. At west end of embankment is gravity spillway containing five outlet conduits.

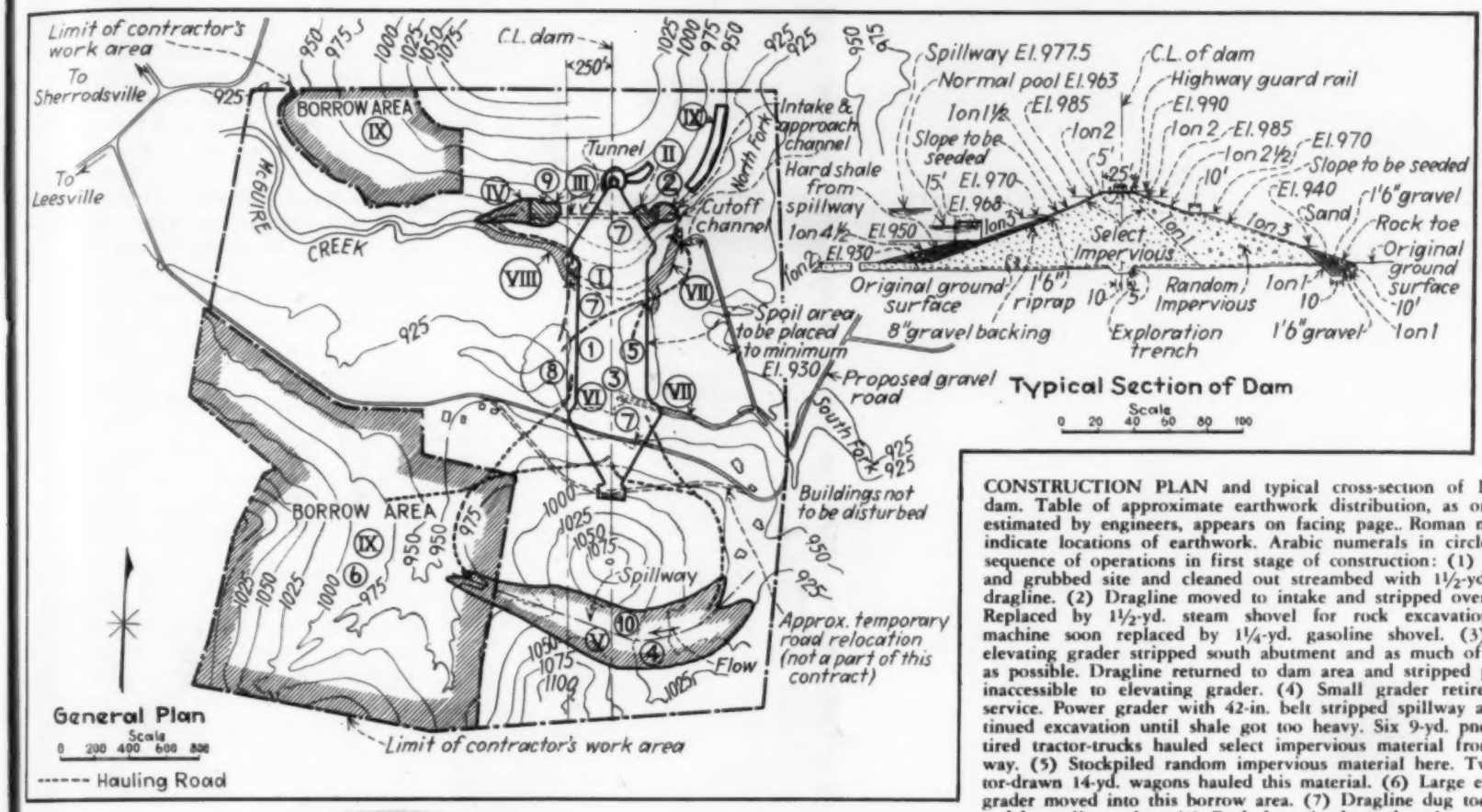
PNEUMATIC-TIRED earth-movers are giving track-mounted carriers a run for their money on thirteen rolled earth-fill dams of the Muskingum Watershed flood-control and water-conservation project in eastern Ohio, where the Corps of Engineers, U. S. Army, directs placement of 9,000,000 cu.yd. of embankment and 900,000 cu.yd. of rockfill and riprap in these structures. While diesel and diesel-fuel engines battle it out with gasoline motors for first place in excavators and tractors on the jobs, pneumatic-tired tractors, trailers, trucks, tractor-trucks and carrier scrapers carry on a stimulating and instructive contest with crawler equipment.

Muskingum Project — An accompanying map indicates the location of fourteen dams now under construction to control the flow from 4,183 sq.mi. of watershed in the Muskingum system north of Zanesville, Ohio. Only one of these structures, the Dover dam, is concrete; the remaining 13 are rolled earth-fill structures with an impervious core and a pervious outer shell protected against erosion and wave action by an outer facing of rockfill, riprap, or large gravel. The entire project involves numerous railroad, highway and utility relocations, within the reservoir areas which add greatly to its cost. For the complete project, the cost amounts to $37,590,000, of which $25,590,000 is con-

DISTRICT MAP indicates location of flood-control and water-conservation reservoir areas formed by thirteen earth dams and one concrete dam in Muskingum River watershed.

Approximate Earthwork Distribution — Leesville Dam

DESCRIPTION	I DAM	II INTAKE AND APPROACH CHANNEL	III TUNNEL AND STILLING BASIN	IV OUTLET CHANNEL	V /SPILLWAY	VI TOPSOIL	VII STREAM CHANNEL ABOVE DAM	VIII STREAM CHANNEL BELOW DAM	IX BORROW PITS	TOTAL
Stripping for embankment	17,000									17,000
Common excavation	25,200	4,800	12,000	14,000	328,000					384,000
Filling stream channel							5,000			5,000
Top soil						11,000				11,000
Excavation in borrow pits								305.000		305,000
Rock excavation	2,700	3,200	3,600	1,000	54,000					64,500
Rock excavation for trenches			100							100
Tunnel excavation			1,800							1,800
Structure backfilling compacted		700	5,300							6,000
Impervious fill in embankment	583,900							2,100		586,000
Rock fill in toe trench	14,500							1,000		15,500



CONSTRUCTION PLAN and typical cross-section of Leesville dam. Table of approximate earthwork distribution, as originally estimated by engineers, appears on facing page.. Roman numerals indicate locations of earthwork. Arabic numerals in circles mark sequence of operations in first stage of construction: (1) Cleaned and grubbed site and cleaned out streambed with 1½-yd. diesel dragline. (2) Dragline moved to intake and stripped overburden. Replaced by 1½-yd. steam shovel for rock excavation. This machine soon replaced by 1¼-yd. gasoline shovel. (3) Small elevating grader stripped south abutment and as much of bottom as possible. Dragline returned to dam area and stripped portions inaccessible to elevating grader. (4) Small grader retired from service. Power grader with 42-in. belt stripped spillway and continued excavation until shale got too heavy. Six 9-yd. pneumatic-tired tractor-trucks hauled select impervious material from spillway. (5) Stockpiled random impervious material here. Two tractor-drawn 14-yd. wagons hauled this material. (6) Large elevating grader moved into this borrow area. (7) Dragline dug toe trench and keywall trenches. (8) Rock from intake and outlet stockpiled here. Steam shovel loads rock from stockpiles into track wagons for placement in downstream toe trench and upstream face. (9) Gasoline shovel excavated stilling basin. (10) Two shovels moved to spillway.

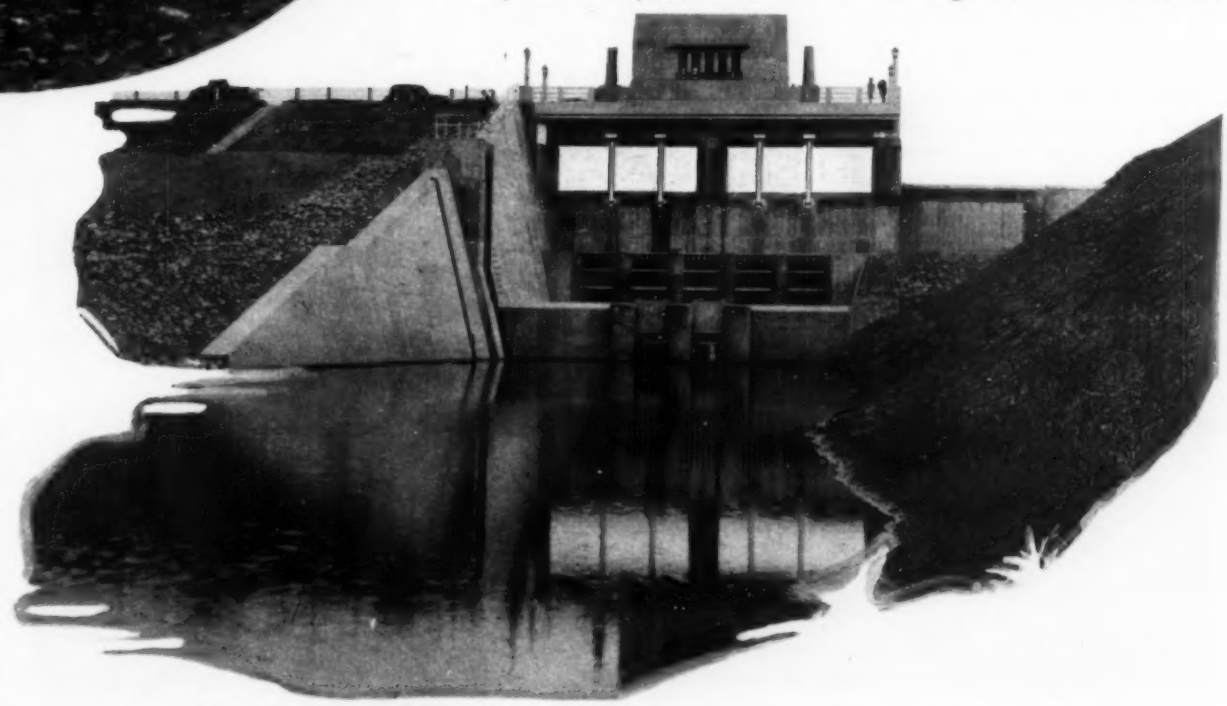
FOLLOWING SHALLOW STRIPPING of top soil at dam site, surface is prepared by plowing and rolling to make firm bond with embankment material.

tributed by PWA, $8,000,000 by the Muskingum Watershed Conservancy District, and $4,000,000 by the state.

Total fill quantities at the earth-fill dams range from a maximum of 1,980,000 cu.yd. of earth embankment and 580,000 cu.yd. of rockfill and riprap in the Mohawk dam to a minimum of 273,000 cu.yd. of earth embankment and 20,000 cu.yd. of rockfill and riprap at Atwood dam. Embankment design at Clendening calls for only 239,000 cu.yd. of earth embankment but involves 136,000 cu.yd. of rockfill and riprap. Concrete structures at the earth fill dams consisting almost entirely of outlet works, require from 53,000 cu.yd. at Mohawk to 6,800 cu.yd. at Piedmont. In all, the 13 earthfill dams require 256,000 cu.yd. of concrete.

Design of Earth Dams—Careful study of topography, foundations, available materials, and relative cost dictated the choice by the Corps of Engineers of rolled earth-fill embankments at 13 sites. Designs for these locations were prepared by the engineers with the aid of accurate field tests and studies conducted in a well equipped soils laboratory at Zanesville. In every case the objective of the design was to assure a structure which will function for many years without decrease in efficiency or factor of safety.

Rocks in the Muskingum basin are sedimentary in origin, being composed of sandstone, shale, or indurated clay. No igneous or volcanic rocks are found. At most sites, rock is encountered only at the abutments and frequently at only one abutment. Valley bottoms are filled with clay, silt, or sand and gravel. At some sites the



OPERATING MACHINERY in house on bridge above spillway controls five 3½x7-ft. gates in outlet conduits at Charles Mill dam. Low conservation pool is retained behind weir upstream from conduits.

TOE TRENCH (*left*) of Clendening dam is excavated by power shovel in preparation for rock filling. Concrete keywall resting on rock at east abutment appears in left background

TRACTOR-DRAWN TRACK WAGONS (*below*) are favored for handling rock at most dam sites in Muskingum district.

dam must rest on clay and silt of low bearing value.

All thirteen earth dams are being built as rolled-fill embankments. Material adaptable to hydraulic-fill placement was found at the Bolivar site, and this method was included in the proposals as optional with the bidder. The method was eliminated by the successful bidder because of the high cost of pumping materials from the available borrow pits.

Materials found in the valley fills varied to such an extent as to present many design considerations. These conditions brought about designs having two primary objectives: Stability of the embankment against seepage and piping, and stability against settlement of the foundation.

In the first class fall the dams, Mohawk, Beach City and Bolivar, lying on deposits of glacial outwash consisting of clean sand and gravel 100 ft. or more deep. The demands of the project are such that the quantity of seepage is of no material consequence so long as the seepage does not produce destructive piping forces. Under such design criteria the expense of absolute cutoffs could not be justified, but the design requirements could be satisfied by the construction of extensive upstream impervious blankets, supplementing thin natural blankets already in place. Additional insurance was provided by extensive, filtered, rock toe drains dissipating the potential forces of seepage.

In the second class fall those dams in the southeastern portion of the district, Wills Creek, Clendening, Senecaville, Atwood, Tappan, and others. These embankments are founded on deposits of silt and clay varying in depth from 8 to 70 ft. In each of these cases a design was produced to assure that shearing stresses induced by the construction of the embankment would not be in excess of the shear strength of the soils in the foundation. In several cases, notably Senecaville, Piedmont and Wills Creek, it was found necessary to flatten the slopes to a considerable extent to produce a safe design. In other cases, Clendening and Wills Creek, it was found desirable to specify the rate of construction so that the loaded foundations could gain shearing strength rapidly enough always to exceed the stresses induced by loading. At Charles Mill and Atwood soil deposits were of such recent and varied nature that the most logical procedure was to excavate 10 ft., more or less, down to rock.

Exploration trenches excavated to a minimum depth of 6 ft. and backfilled with selected impervious material were specified for all the embankments. In addition to breaking the continuity of pervious foundations and assuring stoppage of seepage resulting from imperfect stripping of top soil on pervious foundations, these trenches served to uncover buried farm drains, which then could be traced and removed.

Rock-filled drainage trenches from 6 to 15 ft. deep are incorporated in the embankment at the toe of the downstream slope. Where a natural impervious blanket exists, the rock-filled trench pierces this blanket and connects with the pervious materials underneath.

DISCHARGE CHANNEL below outlet tunnel at Leesville dam is trimmed by dragline. Curved and stepped apron drops tunnel discharge into stilling basin.

LEESVILLE DAM CORE of select impervious material is built up by pneumatic-tired tractor-trailers hauling material from saddle spillway and borrow pits. Bulldozer spreads material in 6-in. layers and sheepsfoot rollers compact it.

Top soil is stripped to a depth of 6 to 12 in. under the impervious and random sections of the embankment to provide an effective bond between the superstructure and the foundation. Under the pervious downstream sections of the embankment, stripping of the top soil provides free drainage where the flow lines concentrate at the

downstream rock toe trench. Depth of this latter stripping varies from a few feet to 5 or 6 ft.

On abutment slopes where rock is found near the surface, the cutoff trench and rock toe are carried up the slope to the top of the dam. In the bottom of the cutoff trench is constructed a concrete keywall about 5 ft. in height, and provision is made for grouting the foundation.

Embankment Design—The Mohawk embankment is the nearest approach to the ideal section, incorporating an impervious core, forming a watertight barrier, and a pervious outer shell supporting the core and allowing free drainage upstream and downstream. The outer shell is made up of materials graded from fine next to the core to rock on the slopes. At Mohawk, a large supply of rock from outlet and spillway excavation is available for the outer shell. Pervious materials for an intermediate section are obtained from channel excavation and nearby borrow pits. Impervious material is available from excavations for the control structures and from borrow pits.

Close approaches to the ideal section are to be found at Clendening and Wills Creek, where an abundance of rock from spillway and outlet excavations provides for the outer shell. Because no strictly pervious material is present at these sites, the rest of the section is made up of random material with an impervious core.

Rock is not available in sufficient quantity at Beach City, Charles Mill, Pleasant Hill and Bolivar dams, but these sites provide an ample supply of coarse pervious materials for the outer shells. Large stones are worked toward the outside slopes to form a protection against weathering, slope erosion, and wave wash. At Leesville and Mohicanville neither durable rock nor strictly pervious material are procurable in quantity, and the outer sections are built up of random materials with riprap protection on the upstream slope. At the four remaining dams, the entire embankment section is made up of impervious material with rock-filled toes and riprap on the upstream slope.

Outlet Works and Spillways—Favorable topography at nine sites dictated the use of saddle spillways consisting of rock cuts with the sides and bottom lined with concrete where the rock is too poor to withstand weathering. Design of the outlet structures depended upon the function of the reservoir. Where the outlet discharge is large and the normal conservation pool retained at a comparatively low elevation, a concrete weir with its crest at normal pool level was placed

ELEVATING GRADER (*right*) in Tappan dam borrow pit loads impervious material into pneumatic-tired tractor-trailers for transportation into embankment.

PNEUMATIC-TIRED SEMI-TRAILER (*below*) dumps load through bottom gates for spreading in 6-in. uncompacted layer by bulldozer. Man with hose wets material thoroughly.

Thirteen Earth Dams — Muskingum Watershed Conservancy District

DAM	CONTRACTOR	ESTIMATED QUANTITIES					EMBANKMENT IN PLACE—Sept. 1, 1936		CONTRACT PRICE	DATE OF AWARD	SPECIFIED COMPLETION DATE	PER CENT COMPLETE Sept. 15, 1936
		Earth Excavation Including Borrow Cu. yd.	Rock Excavation Cu. yd.	Concrete Cu. Yd.	Earth Embankment Cu. yd.	Rockfill and Riprap Cu. yd.	Earth Cu. yd.	Rockfill and Riprap Cu. yd.				
Atwood	W. L. Johnson Construction Co., Hicksville, O.	309,000	18,800	11,600	273,100	20,000	89,800	1,000	$434,501	July 3, 1935.	July 22, 1937	34
Beach City	Wm. Eisenberg & Sons Inc., Camden, N. J.	1,433,000	156,700	28,700	1,030,100	30,700	688,800	17,000	1,162,440	Feb. 28, 1935	Nov. 14, 1936	66
Bolivar	Minder Construction Corp., Chicago, Ill.	2,356,000	163,000	37,400	2,157,700	44,200	1,143,600	600	2,010,321	July 2, 1936	Dec. 3, 1937	58
Charles Mill	Ryan & Myers Campbellsburg, Ind.	602,300	44,297	16,400	381,800	10,500	381,800	10,500	520,497	Dec. 5, 1934	Aug. 17, 1936	100
Clendening	The Glen Falls Indemnity Co., Glen Falls, N. Y.	279,400	105,700	4,800	239,400	136,700	151,300	90,400	421,741	Feb. 7, 1935	Aug. 30, 1936	70
Leesville	The Culbertson Construction Co., Cleveland, O.	670,000	157,600	7,900	572,900	15,300	336,700	8,200	630,175	May 28, 1935	Dec. 27, 1936	54
Mohawk	George M. Brewster & Son Inc., Bogota, N. J.	2,270,200	616,400	53,700	1,983,800	587,000	1,026,300	288,000	2,312,241	Mar. 28, 1935	Aug. 30, 1937	71
Mohicanville	Winston Brothers Co., Minneapolis, Minn.	335,700	59,700	13,900	283,200	17,500	190,600	11,300	442,540	May 7, 1935	Dec. 27, 1936	71
Piedmont	Hamer Brothers Inc., Greenville, O.	750,800	110,600	6,900	652,600	84,400	547,900	86,500	607,012	April 22, 1935	May 23, 1937	77
Pleasant Hill	Newhall-Herkner Construction Co., & Peter Herkner Cleveland, O.	591,200	217,100	20,900	505,100	218,300	67,700	53,600	1,039,148	June 28, 1935	Oct. 9, 1937	35
Senecaville	J. A. Mercier Co., Detroit, Mich.	445,600	53,700	19,600	367,700	80,300	257,700	64,200	534,988	April 29, 1935	Jan. 20, 1937	74
Tappan	Sammons—Robertson Co., Inc., Huntington, W. Va.	820,900	75,200	7,600	813,900	66,200	811,000	37,800	602,569	Nov. 30, 1934	Aug. 1, 1936	98
Wills Creek	Edward J. Eiff Co., Quincy, Ill.	601,000	201,200	27,000	493,500	119,200	364,500	69,500	1,040,363	Jan. 23, 1935	July 13, 1937	65

PNEUMATIC-TIRED TRUCKS of 6- and 7-yd. capacity haul all classes of material at several projects, providing rapid earth-moving ability when hauling conditions are reasonably good.

upstream from the intake, as at Beach City and Wills Creek. The weirs are omitted at Mohawk and Bolivar as these dams will retain no permanent pools. Outlet works resembling waterworks intakes were designed for Tappan, Clendening, Piedmont, Leesville, and Atwood dams, as these reservoirs have a high conservation pool level which will be only 10 to 12 ft. below spillway elevation. At Charles Mill, Mohicanville, and Senecaville, the outlet works have been combined with spillways, which consist of gravity dams discharging water on to an apron built in steps, admitting the water to the stilling basins downstream from the outlet works. Pleasant Hill has a special design consisting of a rectangular intake tower 160 ft. high which drops water vertically through slots in three of the walls into a pool and then into a 14-ft. 3-in. tunnel. The spillway is of the morning-glory type, consisting of a vertical shaft which connects with a 19-ft. tunnel ending in a stilling basin below the dam.

Embankment Materials—Advanced construction methods and rigid field control allowed wider range in choosing materials for Muskingum Valley dams than had been possible in the past. Wherever possible, rehandling of materials from structure excavations was avoided by placing the material directly in the embankment. The construction schedule thus affected the design of the embankment to some extent.

Impervious sections of the embankment and impervious blankets are built of clay-carrying earths. Embankments incorporating a large proportion of broken down shale have been found most satisfactory in the Muskingum district. When typical shales are spread heavily and watered on an embankment, the water breaks down the outer surface of the fragments, which become covered with a film of clay. Bulldozing and compacting with sheepsfoot rollers break up the fragments and crowd them together into a cemented mass. With the harder shales, it is found advisable to bring some clayey earth into the embankment along with the shale and spread and bulldoze the two materials together.

In all cases some part of the impervious section consists of clayey earth. Embankments with a high shale content usually weigh more than 135 lb. and often more than 140 lb. per cu.ft., about 10 lb. heavier than the conventional earth material. The stability of the shale embankment is great, and the consolidated material has the watertightness of clayey silt.

Pervious parts of the embankments are of sandstone, gravel and sand. Where supplies are limited, the design provides that these materials be placed in those parts of the embankment where they will be most useful.

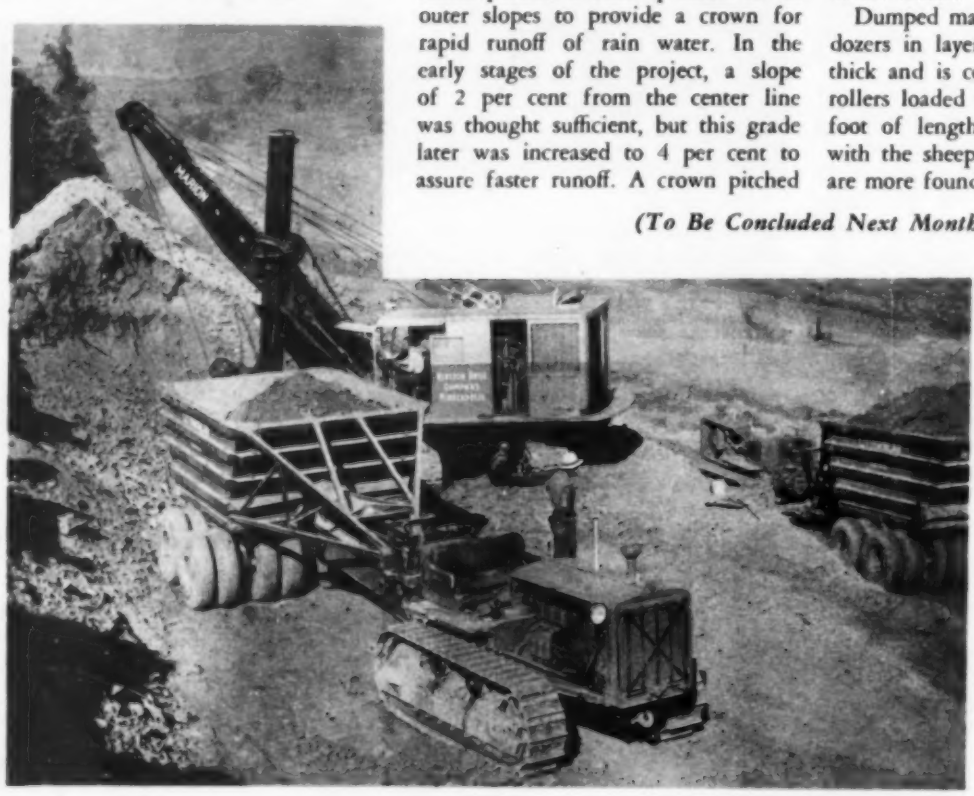
Methods of Construction—At the start of each embankment, the original ground surface was stripped of organic matter, plowed or roughened, and rolled. Similar procedure is followed when new embankment is placed on or against old embankment—for example, when closing sections are being constructed. Where an opening is left in an embankment to accommodate a stream or for any other purpose, end slopes are kept as flat as 1 on 3 or flatter. Before any new embankment is placed against the old, dry material is bulldozed off to uncover earth in the moist condition typical of rolled embankments. When the new material is dumped against this moist surface, the new and old materials are bulldozed together to assure a complete bond.

In starting a new embankment, the center portion is built up ahead of the outer slopes to provide a crown for rapid runoff of rain water. In the early stages of the project, a slope of 2 per cent from the center line was thought sufficient, but this grade later was increased to 4 per cent to assure faster runoff. A crown pitched 4 per cent both ways from the center line drains faster than do the borrow pits and roads to the embankment, except where it happens that the material on the embankment is left fresh and uncompacted. When possible, material is dumped from the center line to the side slopes rather than from the side slopes to the center in order to keep rain water from ponding on the embankment.

Before new material is placed on the embankment, the surface of the last layer is sprinkled with a hose. If the new material is dry, water is hosed into it as it is dumped, a procedure which is found preferable to wetting the material after it has been dumped, as the latter method produces excessive moisture in spots. Excavated materials are usually found damp, and the amount of water which has to be added does not average more than 2 to 4 per cent. In the early morning little water is needed, but in the afternoon of summer days much more has to be added.

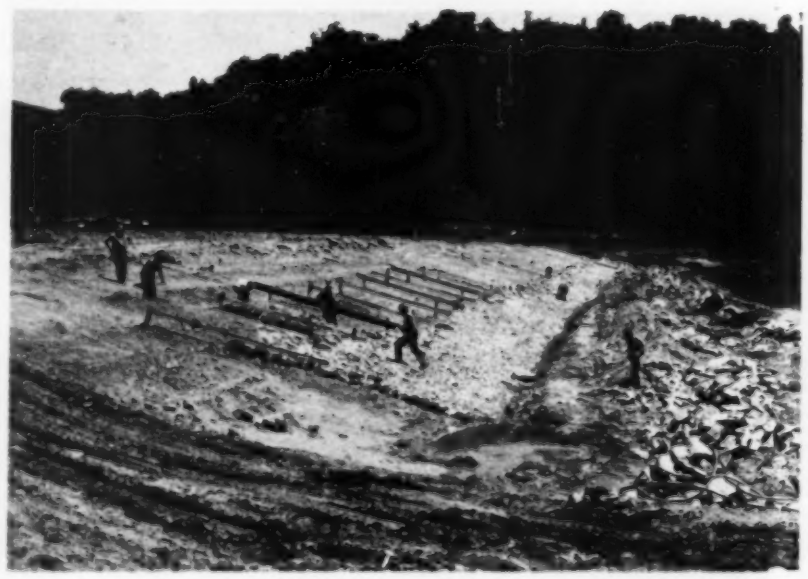
Dumped material is spread by bulldozers in layers not more than 6 in. thick and is compacted by sheepsfoot rollers loaded to weigh 1,000 lb. per foot of length. Six passes are made with the sheepsfoot rollers and rarely are more found necessary.

(To Be Concluded Next Month)



30-YD. CARTS (*left*) riding oh sixteen pneumatic tires move earth in large volume at two projects. Three of these carts serve construction of 300,000 yd. embankment at Mohicanville dam.

BATTER BOARDS (*below*) on upstream face of Tappan dam assure accurate subgrade and true grade on riprap placed to protect earth embankment from erosion and wave wash.



Concrete Treated by

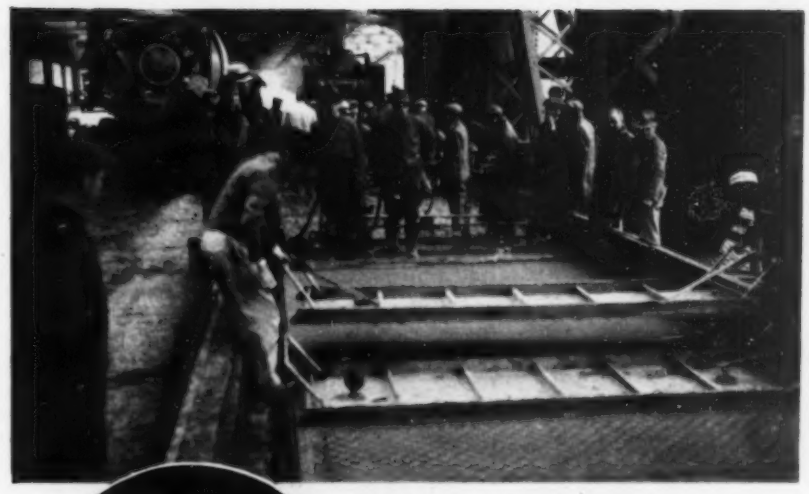
Vacuum Compression

VACUUM-COMPRESSION for treating a freshly poured concrete road slab to remove excess water and compact and strengthen the mix in place was demonstrated Sept. 29 on the northerly traffic lane of the Manhattan approach span of the Queensboro Bridge, New York City, which is receiving a new reinforced concrete deck to replace the old steel buckle plate and wood block floor system installed when the bridge was completed in 1909. (See *Construction Methods*, August, 1936, pp. 28-32).

For the test of the new method of treatment a 68-ft. long section of 10-ft. wide concrete slab, 7¾ in. thick, reinforced with bar truss mats, was selected. From truck mixers carrying 4-cu. yd. batches concrete was chuted into the forms and leveled off with a heavy steel screed and vibrated preparatory to applying the vacuum-compression treatment. The mix was 1:1½:3¼, using a ¾-in. trap rock for the coarse aggregate and Incor high-early-strength cement. Water added to the aggregates amounted to approximately 4⅓ gal. per bag of cement, (128 gal. of water and 29 bags of cement for a 4-yd. batch of concrete), resulting in a concrete with a slump of from 2½ to 3 in.

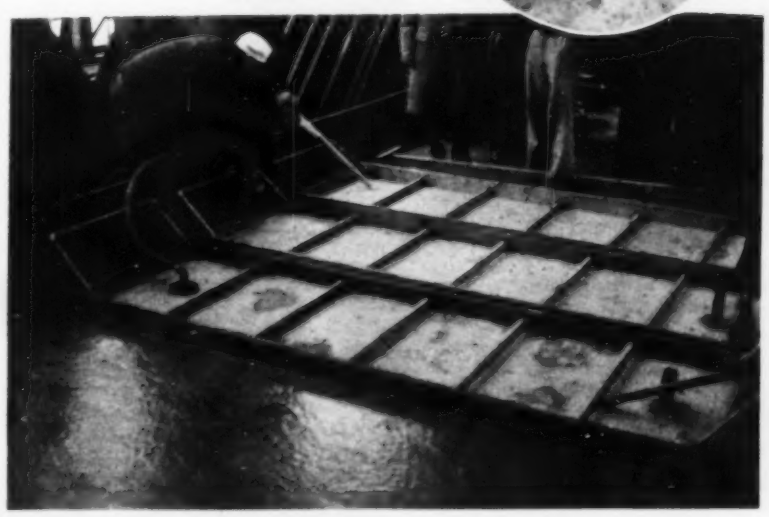
The vacuum-compression treatment is a process developed by the Vacuum Concrete Corp., of New York City. Upon the wet concrete surface are placed, one alongside of another, three 3x10-ft. wood frames or vacuum units, each covered on top with an airtight sheet of No. 18 gage galvanized iron and on the botttom by a tightly stretched sheet of canvas treated with a copper solution to harden its fibres. Between these top and bottom covers is sandwiched a separating mat of expanded metal which forms a compartment ⅛ in. thick, to which suction is applied through a 1-in. hole in the galvanized metal cover by a hose line from a vacuum pump on a motor truck. Underneath the canvas bottom of each frame is a grid in the form of a punched metal plate ⅛ in. thick, with 2½-in. square openings, whose function is to score the concrete surface as an anti-skidding measure.

By means of handles at the ends, the three frames are firmly bedded alongside of each other upon the soft concrete surface of the slab. Then rubber cups on the ends of the vacuum hose line are placed over the 1-in. openings in the galvanized iron sheets forming the top covers of the frames. The suction thus created by a vacuum of 23 to 26 in. of mercury above the top surface of the concrete performs two functions: It removes excess water from the concrete mix and at the same time enables atmospheric pressure, acting upon the top surface of each frame, to bear down upon the concrete, compacting and consolidating it. About 20 per cent of the water is thus removed from concrete of the consistency used on the Queensboro bridge. Where the water-cement ratio of the mix is higher—say 6 gal. of water per bag of cement—it is claimed that 40 per cent of water can be removed from the concrete in place by the vacuum-compression process.



VACUUM FRAME UNIT is shifted from treated strip of slab in foreground, to new setup.

TRUCK MIXERS *(right)* carrying 4-cu.yd. batches chute concrete into forms for 10-ft. wide bridge roadway slab.

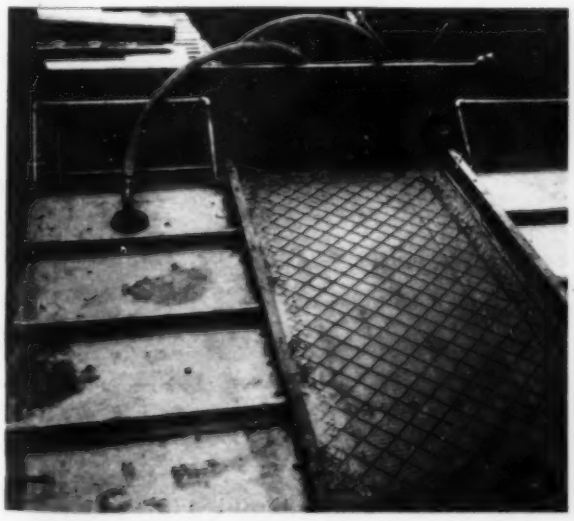


THREE VACUUM PRESSURE UNITS in place on freshly screeded concrete surface.

The vacuum is applied for a period of about 5 min., when the frames are raised and transferred to a new strip of slab.

The chief advantages claimed for the process are that, by the combination of pressure and suction, it not only produces a strong, dense concrete but allows the use of a concrete mix containing enough water to be easily workable during placement, after which the excess water is removed by the vacuum treatment so as to convert the mix into one of dry, no-slump consistency, with consequent increase in strength. In finishing a concrete road slab free water and impurities ordinarily are brought to the surface and result in a sloppy mix at that part of the slab subject to maximum wear, although the intent of all specifications is to obtain as low a water-cement ratio as possible. With the vacuum-compression process, however, it is claimed that the concrete at the top of the slab is drained of excess water and converted into a hard, no-slump mix.

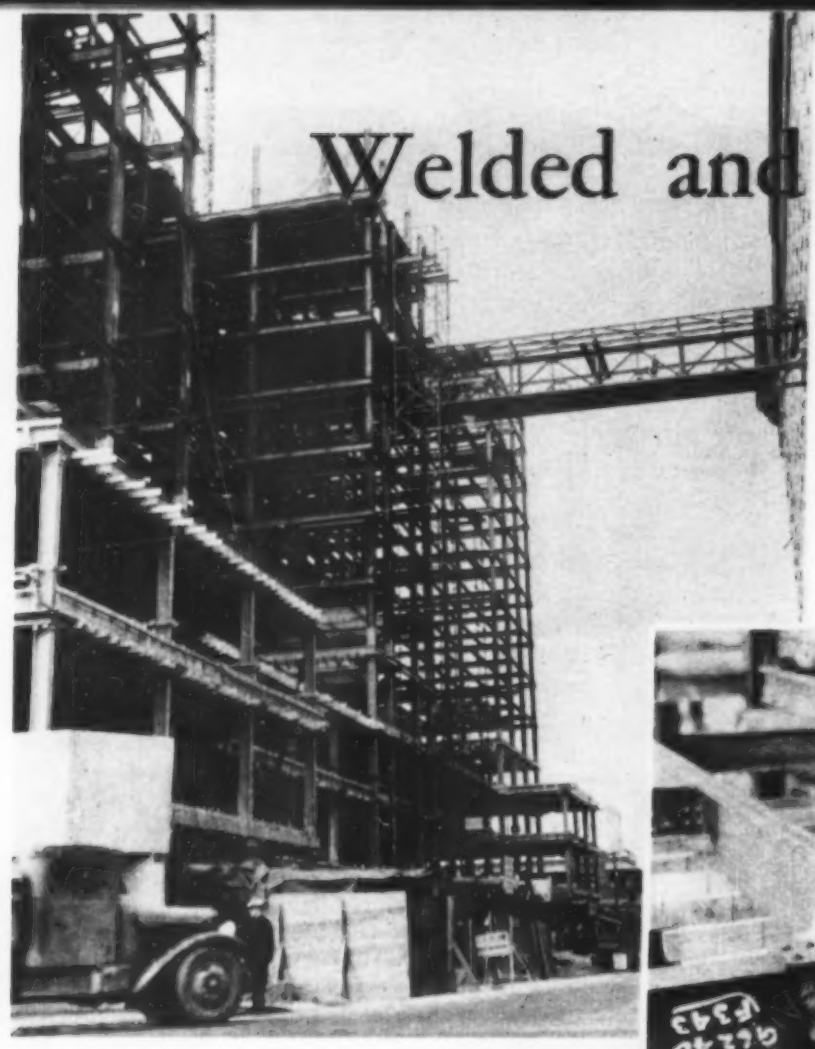
For the Vacuum Concrete Corp. the demonstration was supervised by its chief engineer, Gunnar Johnson, and was witnessed by a group of engineers and city officials, including S. Hamburger, engineer in charge of the Queensboro bridge and Deputy Commissioner E. J. McGrew, Jr., of the city's Department of Plant and Structures.



RUBBER CUP forms connection between frame and vacuum hose line. Treated strip, with frame removed, at right.

UNDERSIDE of vacuum frame unit showing canvas bottom protected by metal grid to score paved surface.

Welded and Bolted Connections Facilitate Noiseless Erection Of Steel Frame Office Building



STRUCTURAL STEEL FRAME of fourteen-story office building rising 202 ft. above street is erected with minimum of noise by utilizing electric-arc welding and manganese steel bolts for connections made in field.

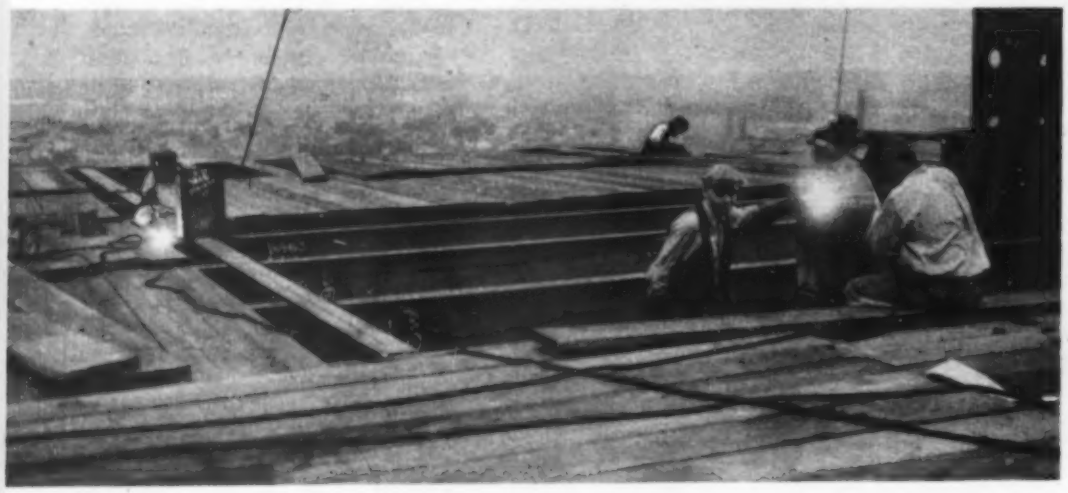
SPLIT I-BEAM CONNECTION of girder to column uses manganese steel bolts to fasten upper - bracket to column flange. Lower girder flange is secured by erection bolts to lower bracket for welding. Column splices are welded in field.

TO MINIMIZE noise in the erection of 2,800 tons of structural steel in a new office building in Wilmington, Del., engineers of E. I. duPont de Nemours & Co., Inc., the owner, designed field connections which utilize fillet welds and manganese steel bolts exclusively. All shop connections are riveted. Girder-to-column connections which take wind stresses are made by: (1) Bolting the upper bracket to the column, and (2) welding the girder to the lower bracket.

Somewhat similar procedure to reduce noise was carried out in the erection of the sixth unit of the main office building in 1930, across Orange St. from the present structure. A major difference in design of the earlier unit resulted from the fact that its frame was tied in at each floor level with adjacent units of the existing building, eliminating consideration of wind stresses. Connections were made entirely by welding, and bolts were used temporarily for erection purposes only.

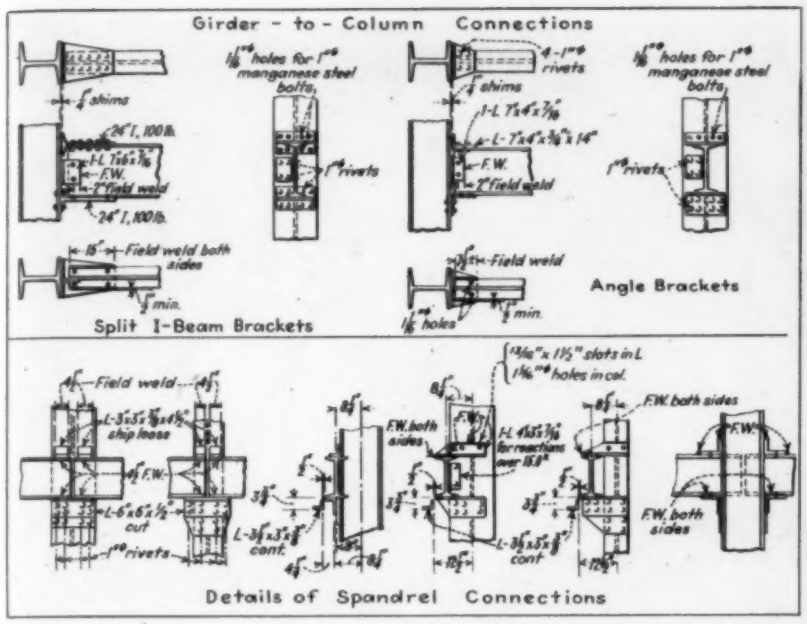
Field Connections — In the present separate office building, 290x100 ft. in ground floor plan and 202 ft. high from street level to the roof of the penthouse, the design had to provide for bending moments caused by wind load. An economical girder-to-column connection was worked out using manganese steel bolts in the upper-flange connection and fillet welds in the lower-flange connection. It was necessary to provide bolt holes for erection purposes in any case, and these holes merely had to be reamed in the brackets and punched in the columns to assure a close fit for permanent bolts. Spandrel connections, which take no wind reaction, are completely welded. An accompanying drawing indicates details of typical connections. Depending upon the value of the reactions, the girder-to-column connections utilize split I-beam or angle brackets.

Welding Operations — Steel erection was carried out by the American Bridge Co., contractor, using three steel guy derricks. All welds in the building were ⅜-in. fillets, deposited in two beads with 3/16-in. coated rod on horizontal welding and in one pass with 5/32-in. coated rod on vertical and overhead welding. The J. K. Welding Co., of Long Island City, N. Y., subcontractor for this work, used nine welding machines (four 400-amp., three 300-amp. and two 250-amp.) in placing a total of 13,400 lin. ft. of ⅜-in. fillet weld in the building. A maximum of eight machines was used at one time, the ninth being a reserve unit. Altogether the work required 7,500 lb. of Una coated rod.



ELECTRIC WELDERS *(left)* deposit fillet welds at framed connections on twelfth floor.

WELDER makes girder - to - column connection at twelfth - floor setback of steel-frame office building.

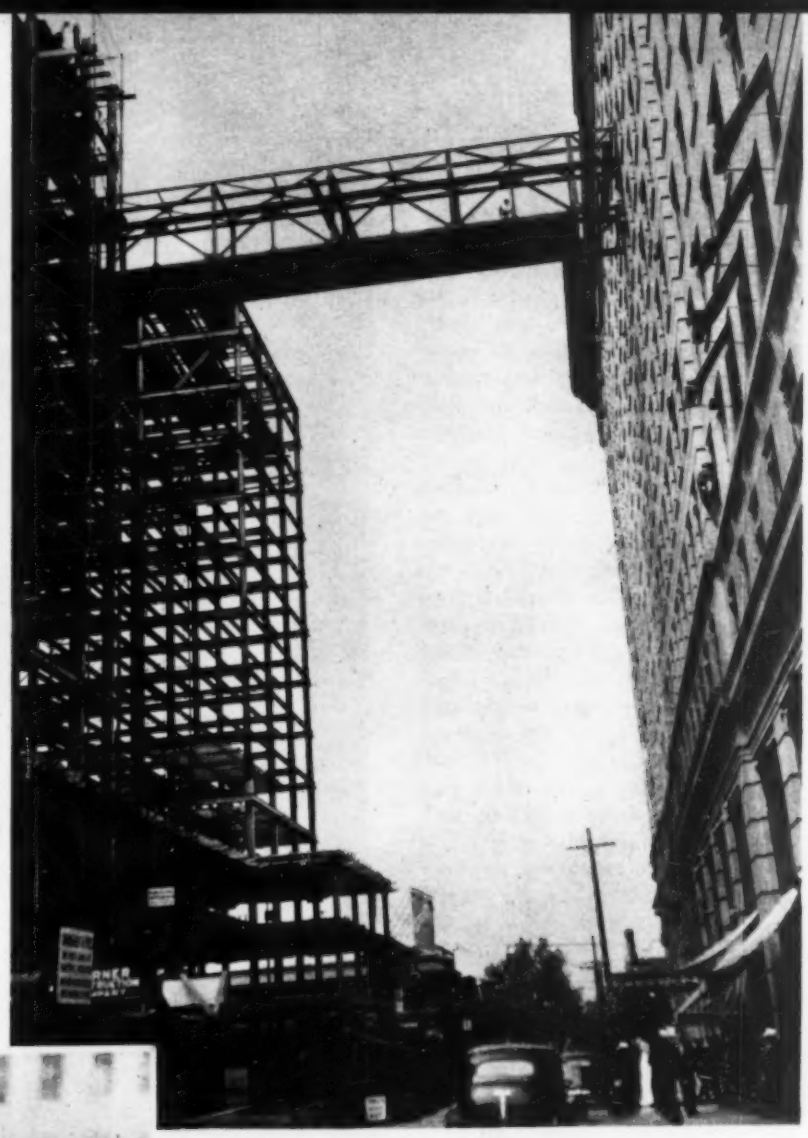


FIELD CONNECTIONS made by welding and by bolting with manganese steel bolts minimize noise in erection of fourteen-story office building. Spandrel connections in field are entirely welded.

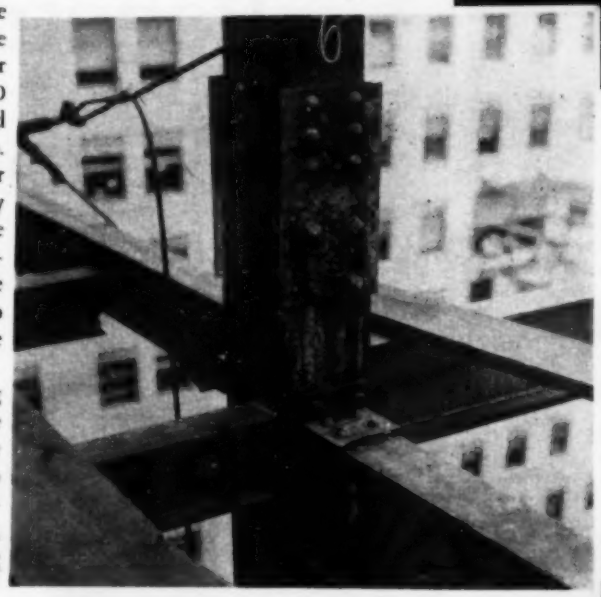
Bolting of the connections offered two advantages. Use of permanent bolts simplified erection and produced some small economies. Bolting also served to draw tight the contact surfaces of column flanges and brackets. Manganese steel bolts used in the structure have an ultimate tensile strength of 75,000-90,000 lb. per square inch; their yield point is 42,000 lb. per square inch. The design is based on an ultimate strength of 20,000 lb. per square inch, giving a safety factor of 4 to 1. Bolts were tightened by steel workers using a 3-ft. pipe handle on a straight wrench. Pneumatic bolting machines were tried but had to be given up because of the objection to noise. Nuts on permanent bolts were tack-welded after tightening.

Progress — Included in the building are thirteen office floors above the ground floor, a pipe loft between the eleventh and twelfth floors, and two floors in the penthouse. Shovel excavation at the site started March 13, 1936, and steel erection and welding were completed July 14. Foundation work required underpinning of an adjacent building with Pretest piling by Spencer, White & Prentis, Inc., in conjunction with sheeting and bracing of one side of the excavation to prevent loss of ground. The thrust on the sheeting was transferred to the completed foundation wall of the office building by placing compacted backfill.

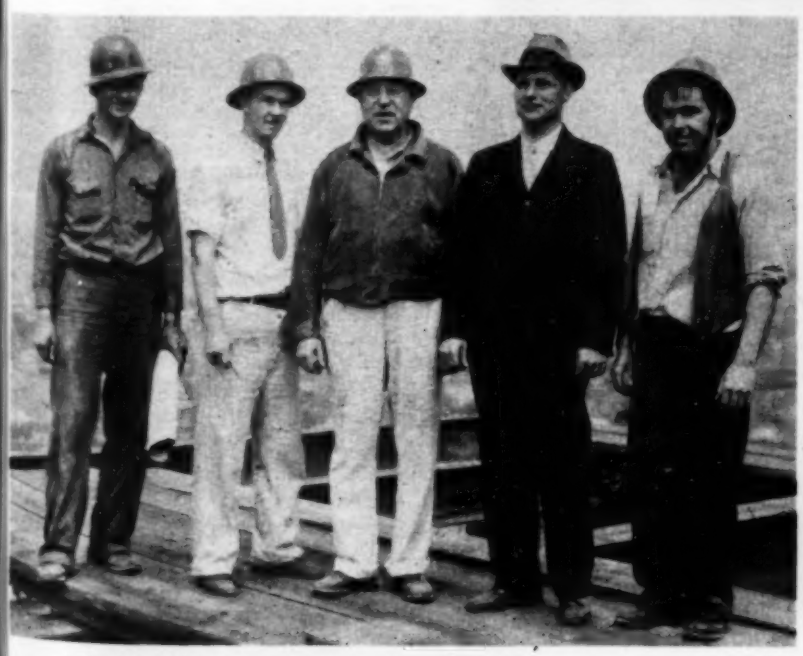
Office floors and ground floor of the new building are air-conditioned by a plant with a refrigerating capacity sufficient to hold interior temperatures 8 to 10 deg. F. below outdoor temperatures. The plant controls humidity inside the building.



CONNECTING BRIDGE at eighth floor between new and existing office buildings has 10-ton steel frame fabricated on street with erection bolts and welding before being raised as unit to span 68-ft. opening between two tall structures.

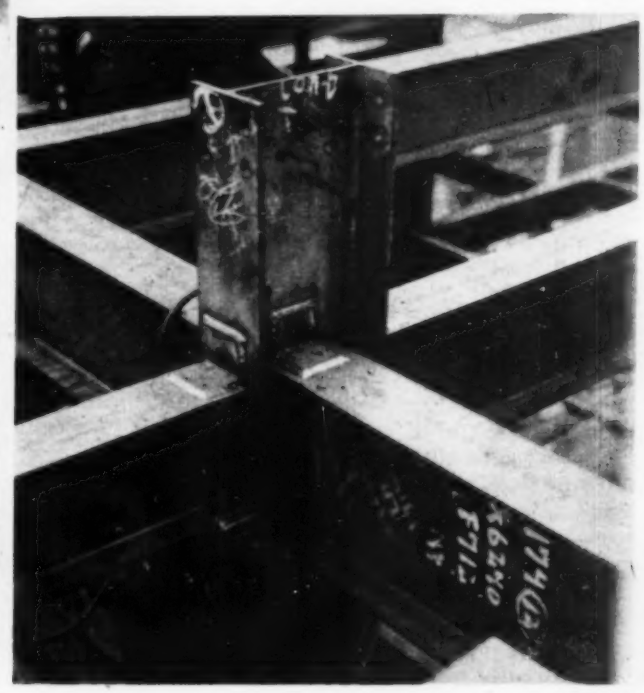


WELDED FIELD CONNECTIONS *(below)* are used for longitudinal girder and light spandrel girder (at left) on upper floor.



ANGLE - BRACKET CONNECTION has upper bracket bolted to column and lower bracket welded to girder flange. Nuts on manganese steel bolts are tack-welded after tightening with wrench.

IN CHARGE of steel erection and welding: *(Left to right)* R. E. Gold, job superintendent, J. K. Welding Co.; T. A. Joyce, building inspector, E. I. duPont de Nemours & Co.; L. R. Hamilton, superintendent, American Bridge Co.; P. J. Kent, general superintendent, J. K. Welding Co., and F. B. Shaw, welding inspector for Carson & Carson, of Philadelphia. All men regularly engaged on job are required to wear protective helmets.



Pennsylvania Builds

Penetration Macadam

On Native Stone Base

FOR A NUMBER of years Pennsylvania has been building penetration macadam on native stone napped in place or crushed. Two contracts recently completed by the N. B. Putnam Co., of Fort Wayne, Ind., offer examples of both types of native stone base. One project employed a base of crushed ledge rock and field stone; the second utilized boulders napped in place.

Two Contracts—A contract on State Route 555 west of Driftwood, in Cameron County, involved construction of 3¾ mi. of penetration macadam 18 ft. wide on an 8-in. base of crushed native stone 18.67 ft. wide. This pavement was placed on a graded section completed 4 years ago. The other contract, calling for equal widths and thicknesses of base and top on 3 mi. of State Route 198 south of Penfield, in Clearfield County, specified a base course of native stone napped in place with hand sledges. This project involved relocation of the highway on a steep mountain side, necessitating excavation of about 70,000 cu. yd. of earth and loose shale from cuts ranging to a maximum depth of 31 ft. on the high side. Practically all this material was needed to build fills to a maximum height of 45 ft. in 8-in. compacted layers.

NATIVE ROCK in broken and ledge formations alongside existing road furnishes material for crushed stone base of new penetration macadam pavement on one contract section. Trucks haul rock from quarry to crushing plant in background.

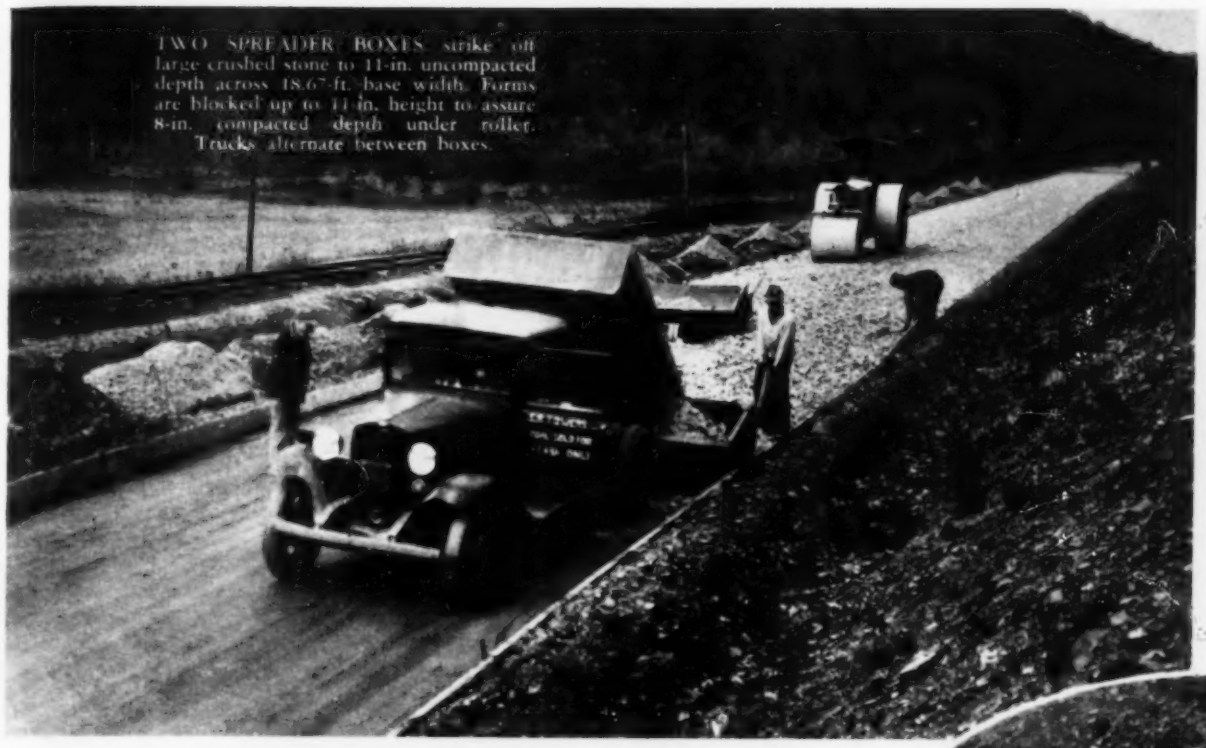
JAW CRUSHER driven by belt from power pulley on tractor reduces rock to required sizes for base and top. Trucks dump native stone into hopper above crusher.

Crushed Stone Base—On the Cameron County project, 3¾ mi. in length, the contractor uncovered an adequate supply of hard sandstone in a bank along one side of the graded road about ½ mi. west of the east end of the contract. A large part of this rock was loose material overlying a ledge which extended back into the hillside on a roughly horizontal plane 4 or 5 ft. above road grade.

SUBGRADE DRAINS *(in oval)* pitched ¼ in. per foot across roadway and ½ in. per foot across berm are opened at average spacing of 250 ft. and are backfilled with stone. Drains are built on skew to avoid any noticeable bump in driving over completed macadam pavement.

On the lower side of the roadway at this point the contractor set up a crushing plant, illustrated by a photograph, with a capacity of about 300 tons of base-course material a day. A Farrel jaw crusher, bucket elevator and screens were arranged in a straight line for belt drive from a Caterpillar 60-hp. gasoline tractor. A supplemental chain drive turned rotary screens above the bins under which trucks were loaded.

Two sizes of stone were used in constructing the base course, the larger size ranging from 1¼ in. to 4 in. and the smaller, filler stone consisting of fragments under the 1¼-in. size. Loose pieces of sandstone from the bank above the ledge were used for base-course material. Pieces too large for the crusher were broken with sledges before being loaded into small trucks by hand. Three of these trucks delivered rock to the crusher, backing up a short ramp to dump into a feeding hopper. The jaws were set to crush the rock to a 4-in. maximum size. A "flat eliminator" consisting of a series of parallel bars was placed immediately below the jaws to catch and



TWO SPREADER BOXES strike off large crushed stone to 11-in. uncompacted depth across 18.67-ft. base width. Forms are blocked up to 11-in. height to assure 8-in. compacted depth under roller. Trucks alternate between boxes.

hold for further crushing any long, flat pieces exceeding 4 in. in their greatest dimension. Oversize pieces which escaped the eliminator were broken by hand after dumping on the subgrade.

Crushed rock dropped into the boot of a bucket elevator which elevated the material about 30 ft. to the rotary screens. For the base-course material only one screen with 1¼-in. openings was required. The bins beneath this screen were divided into two compartments with a capacity of about 30 tons each, one for the large stone and the other for the filler.

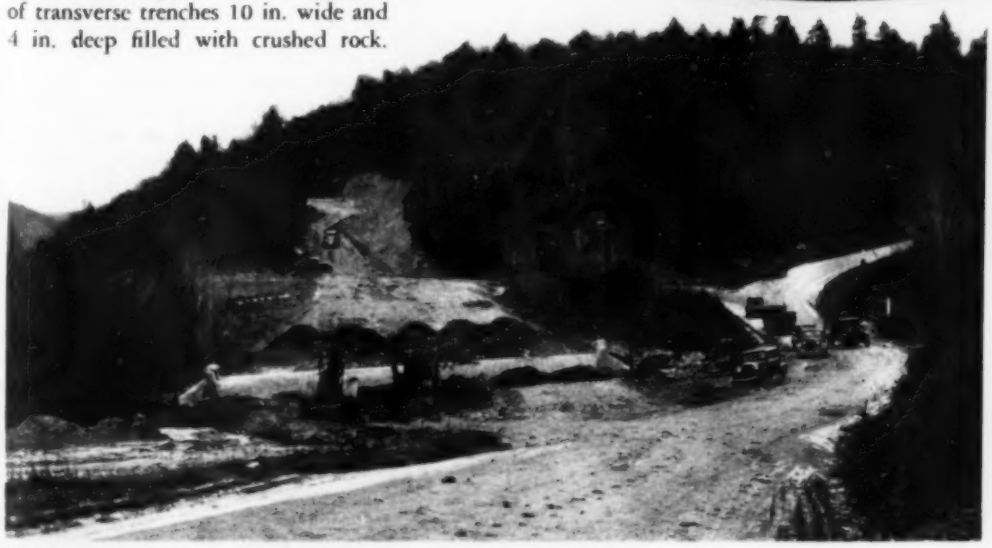
Fine Grade—Prior to the final fine-grading operation, earth berms to retain the base stone were built along both edges of the roadway and compacted with a heavy roller. The fine grade itself was finished to accurate grade and profile. Deviating somewhat from conventional macadam design, this project called for a 2-in. parabolic crown in the subgrade and a 2-in. roof (or A-shaped) crown in both base and top. Another innovation was the use of subgrade drains consisting of transverse trenches 10 in. wide and 4 in. deep filled with crushed rock. These trenches have a fall of ¼ in. per foot across the roadway and ½ in. per foot across the berm. They are located at points selected by the engineer to give most effective subgrade drainage and are built at something less than a right angle with the center line of the road. The contract provided slightly more than 3,000 lin. ft. of these subgrade drains, allowing an average spacing of 250 ft.

After grade cords had been strung, the existing surface was scarified where required by a hydraulically controlled tooth scarifier on a Buffalo-Springfield two-cylinder gasoline roller having a total weight of about 13 tons. The subgrade then was shaped with a Galion motor grader, assisted where necessary by hand labor. Final compaction was obtained with the heavy roller.

Base Construction—Large-size stone for the base was delivered by trucks to two Galion spreader boxes, each serving one-half the width of the road. The trucks dumped their loads into the boxes and pulled the spreaders forward to distribute the material. For ordinary progress of 300 to 350 lin. ft. of base per day, a fleet of three 3-ton trucks and two 5-ton trucks proved adequate. To allow for compaction under the roller, the contractor found it necessary on this project to build up wooden side forms to a total depth of 11 in. The loose rock was spread flush with the tops of these forms, and over-size flat pieces uncovered in the spreading operation were broken with a sledge.

WHEN TRUCK HAS FINISHED DUMPING, workmen level stone with two-handled rake. To obtain proper depth of stone as spreader box is drawn forward by truck, men lift rear gate by long handles.

ALUMINUM BODY on dump truck reduces dead weight and increases pay load capacity.



ROAD RELOCATION (*left*) to save distance on second contract section requires heavy cuts and fills with long concrete culverts. Tractor - bulldozer and roller are placing compacted backfill against culvert in foreground. Shovel in background is taking out first lift of 30-ft. cut involving 35,000 cu. yd. of excavation.

A Galion 10-ton three-wheel roller driven by a four-cylinder gasoline engine compacted the stone by longitudinal rolling, going back and forth over the surface until the stone fragments were locked and keyed securely. When complete stability had been obtained, filler stone was scattered across the surface by hand from piles along the berm, where the material had been stored in advance. Rolling was continued to work the filler stone into the base, aided by brushing with a wire broom attached to the roller to sweep the filler material into the voids.

On the third day of base construction, the organization was able to complete 260 lin. ft. of base course in 10 hr. Production later increased to an average of about 325 ft. per day and reached a maximum of 400 lin. ft. on some days.

FILLER MATERIAL (*left*) on second project consists of sand and fine gravel from natural deposit placed on base stone by endgate dumping from moving truck and spread by hand.

BY KEEPING OPEN SPACE (*below*) between pile of rock and napping face of base, nappers obtain uniform breakage and miss no large stones in bottom. In each group of five workers, two men place and three men nap stone.

Base construction started late last fall. As soon as cold weather put a stop to this work, the contractor began crushing and storing rock for the 3-in. penetration macadam top. Because this rock had to be crushed to small sizes, the capacity of the crusher was reduced to about half of that attained on base-course material. Hard sandstone in the ledge first had to be accepted by the testing laboratory of the State Highway Department for use in the binder and wearing courses of the top. The contractor then drilled and blasted the rock for crushing. For this purpose an Ingersoll-Rand stationary 10x10-in. compressor was set up at the crushing plant to operate a wagon drill and hand drills. The two courses of the macadam top were constructed this summer. Penetration work on this contract started late in July and was completed Aug. 20.

Relocated Highway—Ordinarily the maximum grade permitted by the Pennsylvania Department of Highways is 8 per cent. On the Clearfield County project, however, adherence to this standard would have required a route about 2 mi. longer than the one selected. To save the added distance, the Department increased the maximum on the climb out of Penfield to 9½ per cent. The grade of the old road on this same mountain ranges from 12 to 15 per cent.

With the opening of the project to traffic July 16, the State Department of Highways completed the last link in a 16-mi. highway from Clearfield to Penfield, providing a saving in hard-road distance of 26 mi. The newly opened highway is being shown on all maps not only as a local short-cut through beautiful mountain scenery but also as a shorter route north and south through central Pennsylvania. For example, the new road offers the shortest route between Washington, D. C., and Buffalo and Niagara Falls, N. Y.

Even with the special tolerance in grade, the project required excavation of about 70,000 cu.yd. One cut involved 35,000 cu.yd. Two Thew-Lorain power shovels swinging 1½-yd. dippers excavated the material, which consisted of about equal proportions of loose shale and earth. The deepest cuts were made in three lifts. One of the shovels was driven by its original gasoline power plant, but the other had been rebuilt about 2 years previously for diesel operation, when the owner made some changes in the working parts of the machine to improve its speed, flexibility and smoothness of operation. Material was trucked from the shovels to the fills in rented equipment. A fleet of about five trucks hauling three dipperfuls each worked in conjunction with one excavator, and a group of about five smaller trucks carrying 2 dipperfuls disposed of spoil from the other unit. Tractor-powered bulldozers spread the material on the fills, where it is compacted to 8-in. layers by Galion 10-ton rollers. One of the tractors was a Caterpillar unit driven by a 35-hp. three-cylinder diesel engine.

IN CHARGE of second project: (*Left to right*) Edgar B. Putnam, general superintendent; J. M. Phillips, grading superintendent; and O. H. Rickenbrode, project engineer.

BUMPS (*below*) in top stone detected by 16-ft. straight-edge (behind stooping man at left) or by eye are reduced by picking, loose fragments from high spots being placed in depressions for further rolling.

Fuel cost for the operation of the diesel equipment was extremely low, according to J. M. Phillips, of Muncy, Penna., from whom the two shovels and the diesel bulldozer were rented. Mr. Phillips' experience indicates that the 1½-yd. shovel, powered with a Caterpillar six-cylinder diesel motor, can be operated for 9 hr. at a fuel cost of $1.43. To operate the 35-hp. diesel bulldozer for an equal period requires about 63c. worth of fuel oil.

Napped Stone Base—Native hard sandstone boulders dumped on a surface which had been carefully shaped

to specified profile were broken with hand sledges before being compacted by a Galion 10-ton roller. This roller, as well as other rollers on the project, was equipped with 24-in. rear wheels in place of the ordinary 20-in. width to meet the specification for use in macadam road construction.

Gray sandstone boulders of uniform quality for the base were hauled from a deposit in the woods on top of the mountain 4 mi. from the job, no satisfactory stone being available at any nearer site. Fourteen loads hauled in Ford V-8 1½-ton trucks with sideboards furnished stone for 100 lin. ft. of 8-in. compacted base. By keeping an open space between dumped rock and the napping face of the base, uniform breaking of all stone was assured, no big ones in the bottom being missed.

A crew of 20 men napping base stone would make 450 to 500 lin. ft. per 10-hr. day. The napping crew worked in four groups of five men each, two of the group placing stone on a face perpendicular to the base and three of the men napping the stone. Occasionally it was found that enough stone had not been dumped to make the required thickness. A hole then would be left in the base to be filled later by hauling back over completed base.

SHEET - METAL PAN (*right*) attached to rigid timber frame is used under distributor jets at start of each trip to assure even joint and avoid fat spots.

to apply the filler material. After the filler had been crushed and rolled into the base, additional test holes were dug to ascertain the final depth.

Top Construction—Top stone on this contract was shipped by rail to Penfield and was dumped from hopper-bottom cars on to a belt unloader in a pit under the track. Six 1½-ton trucks hauled the stone to the road, where the material was spread by two Galion spreader boxes 8 ft. wide. The trucks started hauling 1¼-2½-in. stone for the 3-in. top

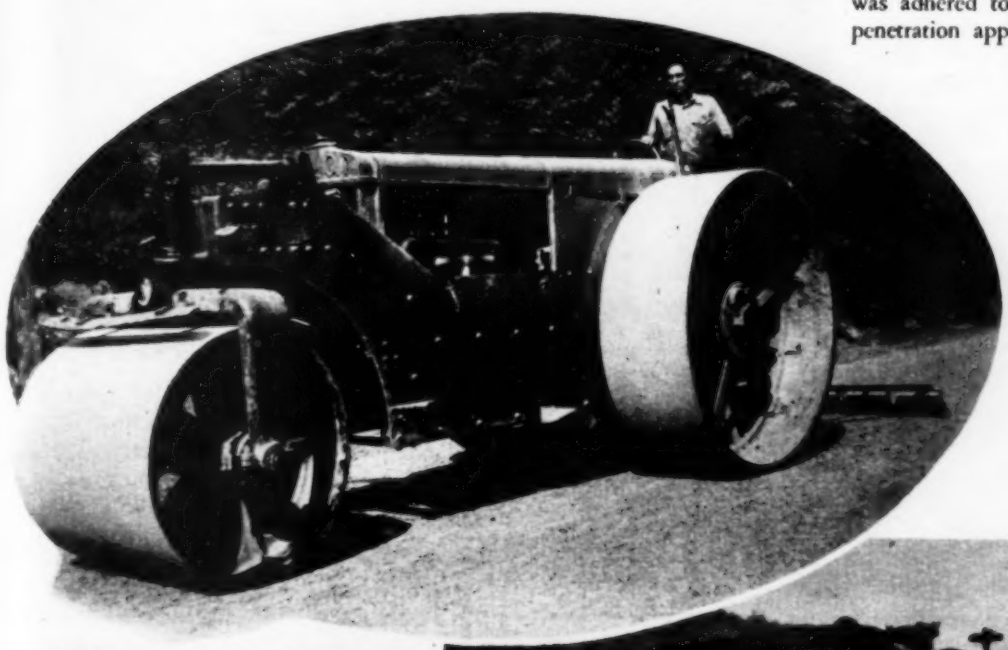
June 26 and finished July 13. Bituminous application was begun by the Ohio Road Improvement Co. of Columbus, Ohio, subcontractor, on June 28, and the surface was completed July 15, being opened to traffic the following day.

Preparatory to asphalting, bumps in the surface were reduced by hand picking, the loose stone thus removed being rolled in to build up low spots. A slight variation from specifications on asphalt application, which had proved beneficial on a previous job, was adhered to on this project. The penetration application was decreased from 1.85 gal. per square yard to 1.7 gal. and the seal coat was increased correspondingly from .4 gal. per square yard to .55 gal.

Before starting a strip of penetration, the jets of the distributor were tested on a pan of sheet metal attached to a rigid frame. This pan proved better than tar paper to assure even joints and avoid accidental fat spots. The pan was drained after each use.

Chips both on penetration and on seal were spread by hand directly from light trucks which backed over the freshly asphalted areas, keeping the chips always ahead of the spreader trucks to avoid sticking. After choke stone had been spread a Galion roller with 24-in. rolls and brooms went over the surface to seat the stone in the pavement.

Personnel—H. H. Temple is chief engineer of the Pennsylvania Department of Highways. The two projects were constructed under the general supervision of W. J. Carroll, district engineer, Clearfield, with Edgar Hewitt and O. H. Rickenbrode, project engineers, in direct charge of the work. For the N. B. Putnam Co., contractor, operations were directed by S. B. Putnam and E. B. Putnam.



10-TON ROLLER (*left*) equipped with 24-in. rear wheels and drag broom goes over pavement surface following application of asphalt and choke stone.

DISTRIBUTOR SPLITS LOAD of 960 gal. of penetration asphalt. Truck loaded with chips, in background, backs over asphalted surface, chips being spread by hand in advance of truck.

Profiles of both subgrade and base course were checked carefully with templets. In addition, the surface of the base was checked longitudinally with a 16-ft. straight-edge. Before giving permission to scatter filler on the base course, the inspectors opened holes in the compacted stone at intervals of 150 ft. to determine the depth to subgrade. Three holes were opened at each location, and the measurements were recorded for the benefit of the central office. In addition to these regular tests, the inspectors made a number of supplemental tests at random to determine the compacted thickness. Only when the depth was satisfactory or had been increased to meet the specifications was permission given

TWELFTH OF A SERIES OF ARTICLES

Planning and Plant for HEAVY CONSTRUCTION

Principles and Practices of Job Layout and Selection and Use of Equipment for Large Dams and Appurtenant Works

By ADOLPH J. ACKERMAN and CHARLES H. LOCHER
Construction Plant Engineer *Construction Consultant*
TENNESSEE-VALLEY AUTHORITY, KNOXVILLE, TENN.

12 . . . Excavating Equipment

A GROUP of foremen and the field engineer were discussing a mean little problem of excavating. A variety of equipment was available for the job, including a dragline, two power shovels and a cableway. The group was concentrating studiously on how to do the job when the contractor himself walked in and, noting the trend of the conversation, remarked: "Now, boys, before you decide what machine to use, you have got to decide where you are going to put the dirt and how you are going to get it there. Are you going to dump it in the spoil bank? Are you going to use it for backfill? Are you going to haul it up to the ridge for the earth dam? Or are you going to take it up to the commissary and sell it for grapenuts?"

This trite remark had the desired effect of pointing out that the term "excavation" in its general use on construction work does not mean "to dig a hole," but "to remove earth or rock *here* and place it *there*." In other words, means of transporting must be considered first in making the best selection of means of digging.

The disposal of material may be to useful purposes, such as building other parts of the work, roads, backfills behind completed structures, developing areas for switchyards or other permanent uses, delivering the rock to the aggregate plant where it is crushed and processed for concrete, or developing an area and a site for the service plant during construction, such as shops and warehouses. At other times a temporary storage of excavated material may be necessary from which it may be later reclaimed for some useful purpose, or it may be dumped directly into a spoil bank.

General Considerations—Among the considerations which enter into the planning of excavation are the total yardage and working time available; the type of excavation and nature of the area, as for example, quarry, ditch, canal, open, confined or subaqueous; and the designed rate of output for the entire plant. One of the most important principles to keep in mind in designing a balanced plant is to take account of the swell of material when it is converted from a solid to a loose state for transportation.

Elements which enter into a proper layout of the work include such questions as where to open up the excavation, which direction to travel, location of ramps, depth of cuts, width of cuts, where to spot equipment to maintain steady production. At all times it is important to keep a balanced running of excavating and hauling equipment and to take fullest account of the natural advantage of the pit layout.

SPOIL BANK of excavated material at Fort Peck Dam.

The actual process of equipment selection requires a consideration of the foregoing elements and their relationship to type of equipment, such as fixed, movable, land, or floating equipment; also the type of power available, such as electric, gasoline, diesel, or steam. Further obvious elements are the questions of ruggedness, ease of replacement of parts and their availability from manufacturers or local agents. The problem of equipment selection for excavation is such an involved task that no detailed rules can be set down. Excavating equipment seldom operates at maximum efficiency, as is evidenced when one considers the vast number of variables which affect the output of such equipment. A representative list of such variables is included in Table 1.

A brief description of the various types of modern excavating equipment follows.

Table 1...Variables Which Affect Output of Excavating Equipment

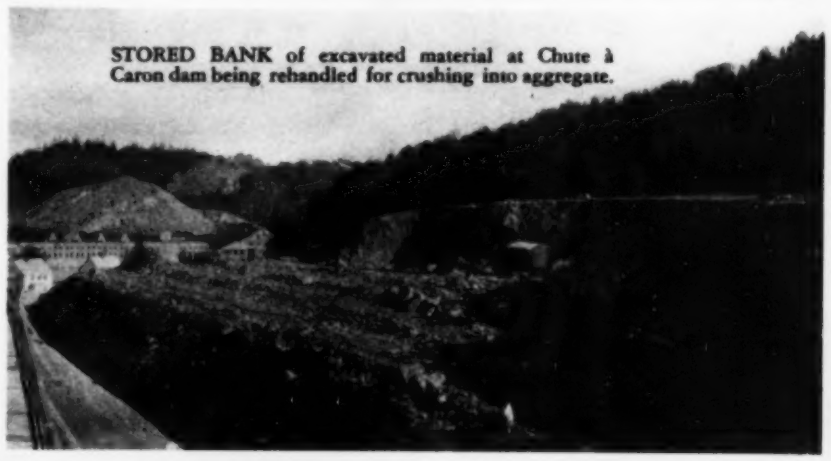
TYPE OF EXCAVATOR	CLASSIFICATION OF VARIABLES—OUTPUT CONTROLLED BY			
	Physical Conditions of Job	*Mat'ls to be Handled*	*Limitations in Machine*	*Method of Operation*
Draglines Shovels Tower Excavators Bulldozers	1. Size of Excavation Area 2. Type of Bottom: (1) Muddy (2) Hard (3) Smooth (4) Rough (5) Sandy (6) Rocky 3. Distance between loading and dumping 4. Required lift—digging to dumping 5. Depth of excavation 6. Proximity to supply of fuel and parts 7. Weather 8. Obstruction and interference from other structures 9. Time available 10. Power available 11. Altitude (effect on engines)	1. Type of material: (1) Sand (2) Gravel (3) Rock (4) Clay 2. Size of pieces 3. Moisture content 4. Foreign matter 5. Weight of material as loaded	1. Size of dipper, bucket or load 2. Angle of swing required 3. Necessary reach—loading to dumping 4. Height of dump 5. Maneuverability of machine under various bottom conditions 6. Speed of machine performance 7. Quality of machine and maintenance 8. Quality of fuel and reliability of supply	1. Number of units in operation 2. Method of Transporting excavated materials 3. Skill & experience of operators and of supervisors 4. Layout of cuts, ramps and roads 5. Deposition of material (loading or spot dumping) 6. Size of receiving units
Dredges	1. Distance to discharge point 2. Presence of trees, roots, vegetation, obstructions, etc. 3. Route to discharge point—by Water or Land 4. Required lift-suction and discharge 5. Anchorage available 6. Proximity to supply of fuel and parts	1. Type of material 2. Size of pieces 3. Abrasiveness of material 4. Foreign matter	1. Size of suction, pump and discharge lines 2. Length of discharge line 3. Suction vacuum on pump 4. Discharge pressure 5. Action of cutterhead 6. Quality of machine and maintenance 7. Quality of fuel and reliability of supply 8. Alignment of pipe line	1. Depth of cut 2. Type of power used 3. Method of carrying discharge pipe 4. Deposition of material (fill or waste) 5. Skill and experience of operators and supervisors 6. Layout of cut 7. Location of booster pumps 8. Method of feeding dredge (Underwater digging or sluice feed)

Table 7... Capacities and Dimensions of Convertible Crawler Excavating Machines

			SHOVEL									DRAGLINE AND CLAMSHELL (*Allowable Load — 66% of Tipping*)									CRANE *75% of Tipping*			
														DRAGLINE				CLAMSHELL						
Rated Capacity	Power	Speed of Travel	Cycle Time Req'd for 90° Swing	Weight Complete Unit Operating	Cost Unit	Length Boom	Length Dipper Handle	Boom Angle 45° Max. Dump Height	Boom Angle 45° Radius at Max. Dump Height	Boom Angle 45° Max. Digging Radius	Rated Capacity	Length of Boom	Angle of Boom	Max. Radius Full Bucket	Load Rating Bucket and Load	Max. Dump Height	Max. Dump Height	Radius at Max. Dump Height	Maximum Digging Radius Full Bucket	Length of Boom	Maximum Load at Radius		Max. Clear Height
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
C.Y.	H.P.	M.P.H.	Sec.	Lb.	Dollars	Ft.	Ft.	Ft.	Ft.	Ft.	C.Y.	Ft.	Deg.	Ft.	Lb.	Ft.	Ft.	Ft.	Ft.	Ft.	Lb.	Ft.	Ft.
⅜	35	1 to 4½	15	16,000	6,000	13	11	12	16	20	⅜	28	42	23	1,825	14	21	15	19	28	7,000	10	27
½	54	1.5 to 0.85	16	28,000	7,000	16	13	14	19	23	½	35	33	32	2,800	15	26	20	30	35	12,000	12	34
⅝	60	0.85	17	32,000	7,500	16	13	14	19	23	⅝	35	35	32	3,300	15	23	18	30	35	13,000	12	34
¾	76	0.85	17	50,000	10,600	18	14	15	21	26	¾	35	35	32	5,000	15	24	21	35	35	21,000	12	34
1	105	0.85	18	70,000	13,200	19	15	16	25	29	1	40	30	40	6,000	15	28	24	36	40	32,000	12	39
1¼	115	0.75	19	80,000	14,500	20	16	16	26	31	1¼	45	30	40	6,800	16	32	27	35	45	39,000	12	45
1½	132	0.75	20	95,000	16,800	21	16	16	26	31	1½	45	34	42	7,700	18	32	27	37	45	49,000	12	45
1¾	148	0.75	20	110,000	19,600	22	17	17	27	33	1¾	50	36	45	9,000	23	36	30	43	50	61,000	12	47
2	170	0.875 to 1.625	21	135,000	25,000	23	18	19	29	33	2	50	38	45	11,000	23	36	30	45	50	77,000	12	55
2½	215	0.55 to 0.92	22	160,000	39,000	27	18	20	30	35	2½	60	28	60	13,000	20	45	35	60	60	95,000	15	65
WARD-LEONARD QUARRY MACHINES																							
2¼		0.75		170,000	35,500	30	18	18	31	36	3 Light	65	35	60	14,000	29							
2½		0.875		226,000	48,000	30	19	22	35	40	3 Heavy	60	35	65	16,900	27							
3		0.75		274,000	59,000	32	22	22	38	43	3½ Heavy	70	34	65	19,850	27							
4		0.91		340,000	70,000	32	22	21	39	45	4½ Heavy	80	35	72	25,500	30							

*Estimated Only

Front and Side Casting Bulldozers— Bulldozers attached to heavy-duty tractors are rapidly being employed as primary excavators and movers instead of serving merely as spreaders or levelers, or as devices for base stripping. According to the U. S. Bureau of Public Roads, a 4x10-ft. blade loads in a distance of 30 ft. when traveling 125 ft. per minute, and carries from 2 to 3 yd. per load. The easiest and most effective work is done in moving earth downhill on short hauls, the limit in grade being such as to permit the machine to reverse and return up hill. Spillage beyond the ends of the bulldozer is prevented by traveling in the same path with built-up sides of earth; the amount of material which can be moved is thereby increased 10 per cent. A similar effect is obtained by operating two bulldozers side by side.



STORED BANK of excavated material at Chute à Caron dam being rehandled for crushing into aggregate.

PENINSULAS at Wheeler dam formed by dumped excavation from power-house area to develop space for shops and storage areas.

In moving loose materials over relatively short distances this equipment is capable of doing the job at from 4 to 7c. per cubic yard.

This equipment is not suited for moving material uphill because the load tends to spill around the ends of the blade. Bulldozers are also very important tools in an excavation plant for keeping the job shaped up at the digging and dumping end, and to facilitate rapid movement of the hauling equipment. Side-casting bulldozers are used in hilly country for opening up jobs where 10-ft. trails can serve as access roads for bringing in heavier equipment.

Table 2 gives some indication of the capacity of the bulldozer as an earth-moving tool:

Scrapers — Scrapers, as a further example of combination excavators and movers, are mostly adaptable to plowable materials; they are not suited to hard rock. In certain kinds of sand the material will not pile up into the scraper, while wet or muddy materials make discharging of the scraper difficult. From small, animal-drawn scrapers the development in recent years has been rapid to the present tractor-drawn 12-yd. size, and in some instances larger sizes. These large capacity scrapers are rapidly gaining acceptance, particularly since they serve as an ideal transporting device, while at the same time eliminating the need for loading

SIDE-CASTING BULLDOZER builds access road to dam in steep hillside country.

equipment. They are specially suited to short hauls of 500 to 1,000 ft. and in some cases up to about 2,000 ft. In general, the loading distance for a scraper is about 100 ft. at a speed of 120 ft. a minute. With loose materials it is necessary to expect heavy spillage when loading on a downhill grade. A scraper leaves the pits as well as the dump area in level shape and thus assists in its own freedom of movement. Since scrapers are essentially a hauling unit, their performance is discussed in greater detail in a succeeding chapter on hauling equipment.

Under average conditions of a 600-ft. haul, the loading and hauling of earth can be done for 5 to 7 c. per cubic yard.

At present there are many makes and sizes of scrapers and no standards have as yet been developed. Some units drag along on their bottom and carry part of the load ahead at slow speed; some have gates in front to reduce spillage; others tilt back during travel. With some of the gate-type units it is difficult to dump sticky material. Some

SCARIFIERS and SCRAPERS make 130-ft. cut and 75-ft. fill on grading contract of 605,000 cu. yd. within distance of less than a mile.

ENGINE-DRIVEN ELEVATING GRADERS are frequently used for digging canals or loading earth for rolled fill dams.

are operated by means of separate engines mounted on the scraper which develop hydraulic or air pressure with corresponding control systems, while others are powered by cables or hydraulic pressure from a power takeoff on the tractor.

Elevating Graders — The elevating grader consists essentially of a tractor-drawn steel frame, which has a plowing "blade" to cut the earth and deflect it on to a short section of belt conveyor. As in the case of scrapers, they are suited only to plowable material. Elevating graders are used for a variety of purposes, as for example, at Pickwick Landing dam, where a large circular pit was developed which eventually formed the excavated area for the power-house site, and the material was loaded and hauled to a rolled fill earth dam. At Fort Peck dam the entire base of the dam was stripped with elevating graders and the earth loaded into trucks and hauled away. A total of 4,100,000 yd. was moved in 120 days, using 9 tractor-drawn graders and 250 trucks. On the best day 55,000 yd. were moved in 14 hr. This system is in marked contrast to older methods such as railroad cars and shovels which, as a matter of interest, were considered for this particular job.

In recent years substantial improvements have been made and the modern units are capable of loading 300 to 400 yds. per hour at from 2 to 4 c. per cubic yard under good conditions.

In the selection of graders the factors which require consideration and govern their output are the nature of soil, its consistency, freedom from stumps and roots; power and speed of the tractor; dimensions of pit and surface conditions; the amount of time lost in turning; the amount and number of hauling units, their capacity, whether large or small; and the clearance under the conveyor arm to permit rapid transfer of hauling units. It is important that hauling units be fast and easily maneuvered in order to make the change under the grader as rapidly as possible to maintain a high output. For the larger jobs it is advisable to use elevating graders with a power unit mounted directly on the grader. On lighter jobs it is customary to operate the belt on the grader by means of a power takeoff from the tractor which pulls the grader. Table 3 gives some indication of the excavating capacity of typical graders:

TABLE 2—BULLDOZER CAPACITY IN SAND OR LOOSE SOIL
(Cu. Yd. Per Hour, Compact Measure. Moved by Bulldozer and 50-Hp. Tractor)

Length of Haul, Ft.	10% Uphill Grade	Level	Downhill Grade 10%	Downhill Grade 20%
50	50	80	150	200
100	30	50	90	130
200	15	26	50	70
300	10	17	30	45
400	7	12	23	33

Power Shovels — Power shovels are best suited to close-range work. They have good control of digging, are speedy and there is little lost motion. Most makes up to 2-yd. capacity can make two to three cycles per minute. Determination of proper size depends entirely upon job conditions, but in any case, it is important to select a size of dipper to suit the capacity of hauling units so as to permit the use of full dipper loads up to the point of spilling over the edges on the last dipperful. It is important not to overtool for maximum output, because this means greater expense when the shovel is shut down. It is well to keep in mind the large number of variables that affect the output of excavating equipment, as has already been mentioned.

There is practically no standardization in the field of shovels, and it is surprising what a high-pressure seller can do in meeting competitive conditions and offering equipment which the unwary contractor does not fully recognize until he has been using it for a while. Such details as short or long dipper sticks, ball or roller bearings or plain bronze bearings, the use of ordinary metals where special alloys would add greatly to the life, or open gears in the place of cut gears fully inclosed and running in oil, all have a decided effect on performance, but may be unobserved details which can be varied to suit the price. Some machines are designed to operate satisfactorily with narrow dragline buckets, whereas a wide bucket is more satisfactory, loads quicker, but requires more power. Maneuverability varies with different makes.

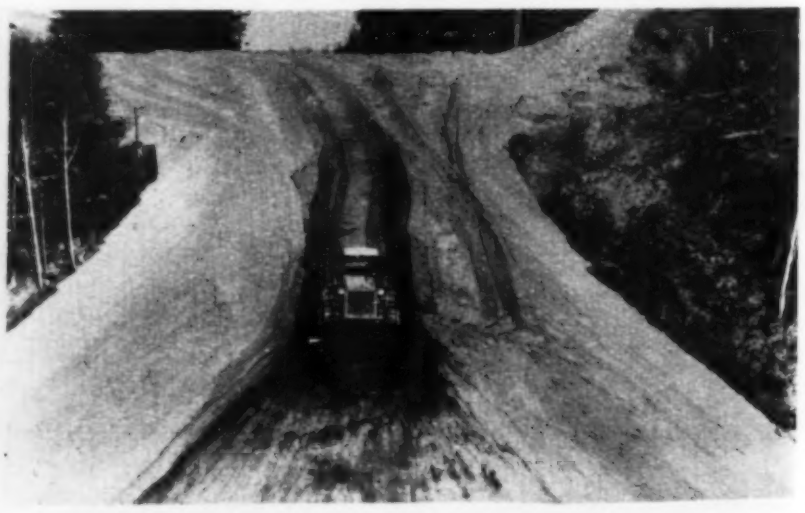
Similar elements go into the selection of engines. Is the horse-power of the engine rated bare or with full auxiliaries, and what is the maximum speed and torque of the machine? A high horse-power at high speed is of less practical value in shovel design, but is frequently offered because such equipment is cheaper. The bigger horse-power sounds important, and this all helps to make a sale.

One of the chief advantages of the modern shovel is its convertibility into dragline, clamshell, crane, scoop, or ditcher, although it should be remembered that some shovels are not as well equipped for conversion as others. Only one or two shovels are equipped for conversion to crane service with a so-called live boom, or a fast-action boom, which is particularly useful in setting steel. Most shovels have worm-gear drives for booming control, which is a slow operation, but a live-boom

TABLE 3—OUTPUT OF ELEVATING GRADERS LOADING WAGONS
(Cu. Yd. Per Hour Compact Measurement)

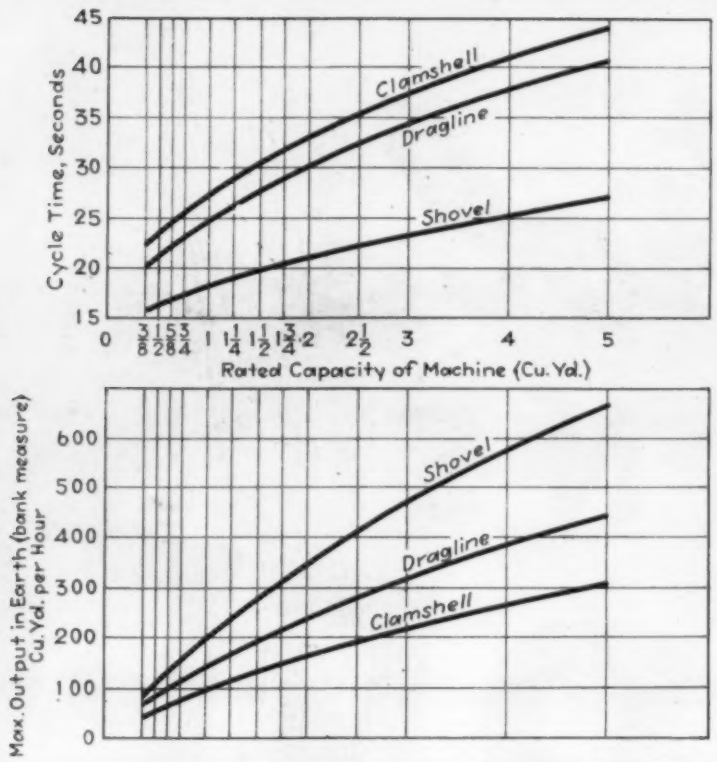
Grader Width of Belt	Belt Power	Tractor	*LOADING CONDITIONS* Excellent	Fair	Poor
42 in.	Power takeoff	Diesel, 50 hp.	215	155	95
42 in.	Engine-mounted	Diesel, 50 hp.	275	200	125
48 in.	Power takeoff	Diesel, 75 hp.	325	240	150
48 in.	Engine-mounted	Diesel, 75 hp.	370	270	170

ELECTRIC-POWERED SHOVEL with 2½-yd. dipper loads rock from foundation excavation at Wheeler dam into trucks.



BULLDOZER in sandy material builds highway cut-and-fill of almost 300,000 cu. yd. across a deep canyon.

SHOVEL UNIT CONVERTED INTO DRAGLINE to excavate material located below its base.



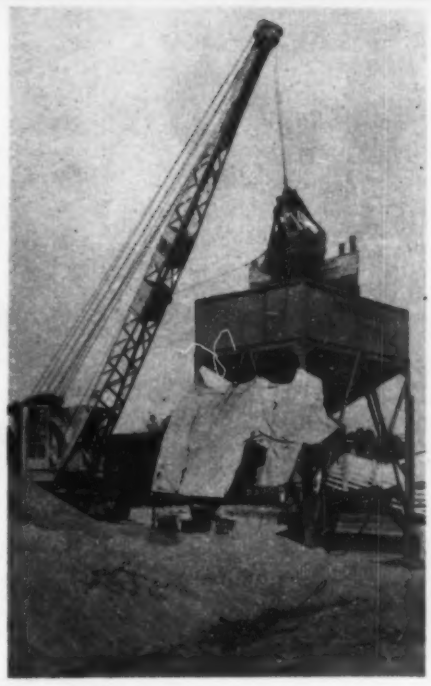
Classes of Material	Coefficient		
	Shovel	Dragline	Clamshell
Light, moist clay or loam which heaps up on bucket or dipper	1.00-1.15	1.00-1.15	1.00
Ordinary earth or loose sand & gravel	0.80-0.90	0.80-0.90	0.80
Light clay mixed with gravel	0.65-0.75	0.65-0.75	0.50
Heavy clay and boulders	0.50-0.65	0.45-0.65	0.40
Blasted rock, hardpan or tough rubbery clay	0.35-0.45	0.30-0.40	0.20

CYCLE TIME AND MAXIMUM OUTPUT
For Shovel, Dragline and Clamshell Operation

Note: This chart indicates the maximum output for favorable conditions, assuming no lost operating time and a 90-deg. swing to dump. The practical output may be 85 to 50 per cent of indicated output depending on skill and experience of operator and local conditions.

Modify output given on chart by coefficients for different classes of material tabulated above.

SHOVEL UNIT CONVERTED INTO SCOOP for picking up materials from level floors.



SHOVEL UNIT CONVERTED INTO CLAMSHELL crane for vertical digging and handling.

machine is actuated by spur gearing, which is considerably faster. When it comes to changing speed for various conditions, some requirements can be met by changing the cable reeving or the lagging on the drums, but here again only one or two machines are equipped with two speeds and with speed changing levers for all operations, which is a great advantage under certain operating conditions.

The extra expense of first-class operating control systems will usually pay for itself many times over. Many of the large excavating units which represent a high investment and therefore demand maximum efficiency of operation, obtain such efficiency by relieving the operator of as much of the "human element" control as possible by using special electrical equipment, known as the Ward-Leonard control system. Such a system consists essentially of a d.c. motor-generator set mounted on the shovel, with a separate motor connected to each machine function, such as hoisting, swinging or crowding. This permits effective control of the equipment through manipulation of the electrical characteristics, and by means of automatic relay equipment all operations are performed under maximum permissible speed and accelerations without overstressing any part of the machine on the one hand, and without sacrificing speed or efficiency on the other.

SHOVEL UNIT CONVERTED INTO DITCH DIGGER or trench excavation hoe.

Draglines — The dragline is one of the most flexible excavating tools. It has more reach than a shovel, both for excavating as well as for disposal, can dig far below its base, as well as at almost any other location, can reach under water, is not seriously affected by weather and permits a great deal of freedom in spotting the hauling equipment for loading, but it cannot handle hard digging as efficiently as a shovel. The boom is generally set at a fixed angle at 30 to 37 deg.

The greatest possibility for mistakes in planning a dragline job lies in the selection of the bucket. For each kind of earth or rock there is one type of bucket which will perform most effectively. It's just like selecting the proper cutting tool for trimming down a piece of metal in a lathe. The combination of width of bucket, balance of bucket, height of bucket, number and angle of teeth and location of teeth with respect to the dragline yoke, and the relationship between length of boom and overall capacity of bucket, all affect the output of a machine in different materials. One successful dragline contractor considers these matters important enough to design his own buckets and pay several times the price of standard buckets, because the extra cost is quickly recovered by the increased output of the machine. Practical dragline performance is too frequently considered satisfactory if the output is 50 per cent of its theoretical ability, largely because the importance of such details is overlooked.

Sometimes easy digging warrants the use of oversize buckets, such as the excavation of sand on the Florida canal, where a number of 1¾-yd. machines were equipped with 2½-yd. buckets on 50-ft. booms. This usually necessitates higher boom angle and resulting decrease in operating range. However, where such an arrangement exceeds the permissible line pull or total weight of the loaded bucket for which the machinery was designed, the greater number of repairs and shutdowns may minimize any advantages.

The capacities of shovel dippers and dragline buckets are commonly stated in terms of level-full measure in cubic content. Thus, a shovel handling earth must be heaped if a load of equivalent bank measure is handled. In handling damp earth the load in terms of bank measure may be about 10 per cent greater than rated capacity. In handling rock the load may be 30 to 50 per cent less than solid measure, depending upon the voids in the rock.

❖

NEXT MONTH — Chapter 13 of the series on "Heavy Construction", by A. J. Ackerman and Charles H. Locher, to appear in the December issue, will continue the discussion of "Excavating Equipment", with particular reference to walking draglines, cableway excavators and dredges.

CONTINUOUS BUCKET DITCHER cuts extra wide sewer trench.

Control MEANS PERFECT

CONTROLLED IGNITION .. REGARDLESS OF VARIATIONS IN DIESEL FUEL OILS

THE ignition point in Allis-Chalmers Oil Tractors is definitely controlled and accurately timed. This exclusive feature not only assures smoother operation and more responsive performance . . . it also gives you a wider choice of Diesel fuel oils. Controlled spark ignition enables Allis-Chalmers Oil Tractors to burn any good grade of clean Diesel fuel. Their performance is not limited by the self-combustion properties of different grades of fuel . . . a definite advantage under actual job conditions.

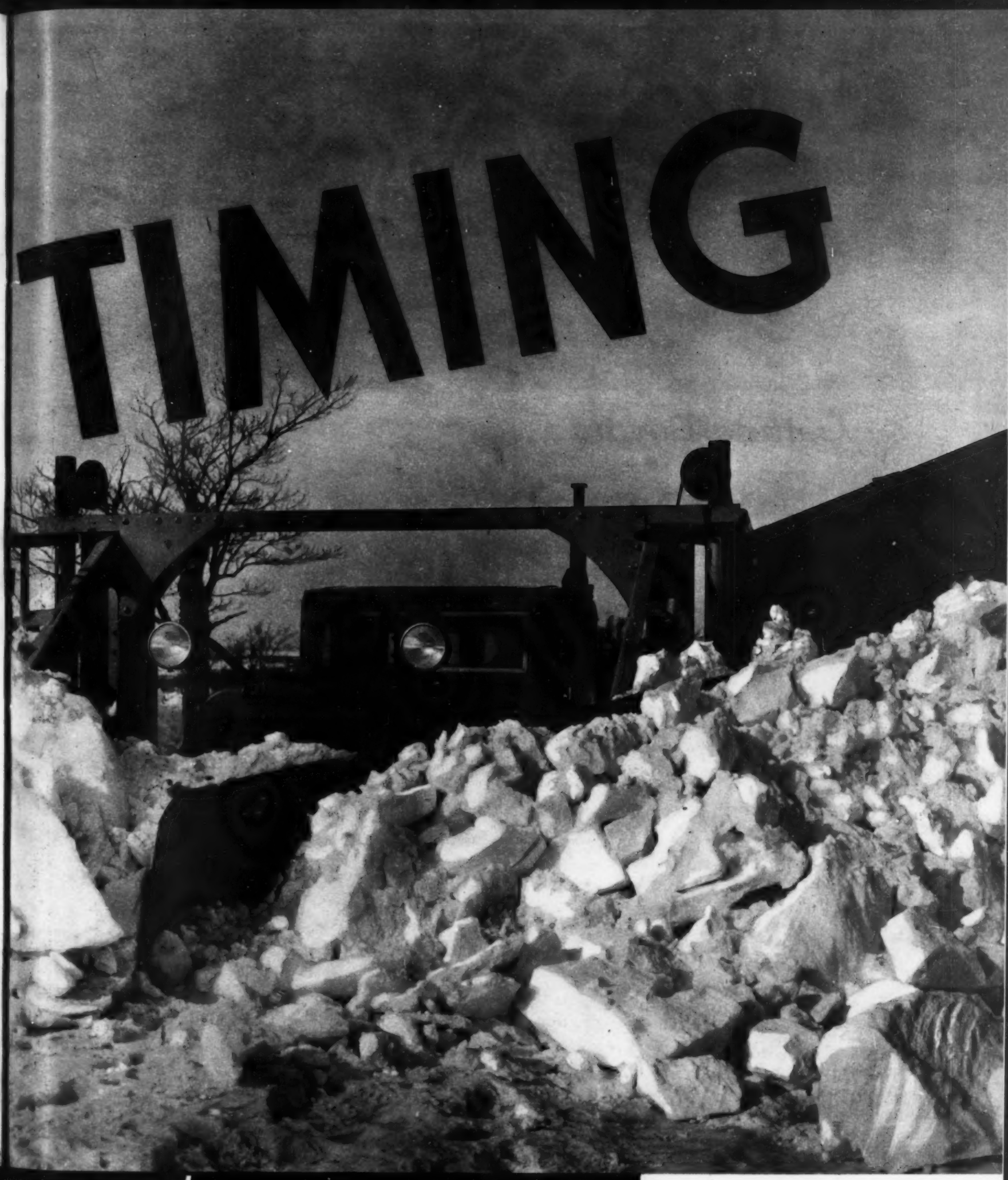
Neither is it necessary to use a special grade of lubricating oil. The spark ignition engine operates with normal compression pressures . . . and without excessive heat. Contamination and breaking down of lubricants is no problem.

For the first time . . . flexibility, balance, smoothness and instant starting have been combined with Diesel fuel oil economy. Investigate now! Branch house and dealer service everywhere.

DEPENDABLE STARTING . . .
DEPENDABLE PERFORMANCE

The built-in quality and dependability of A-C tractors proves itself when conditions are most severe. Instant starting—regardless of weather .. quick maneuvering .. power .. traction .. and the durability to KEEP GOING!

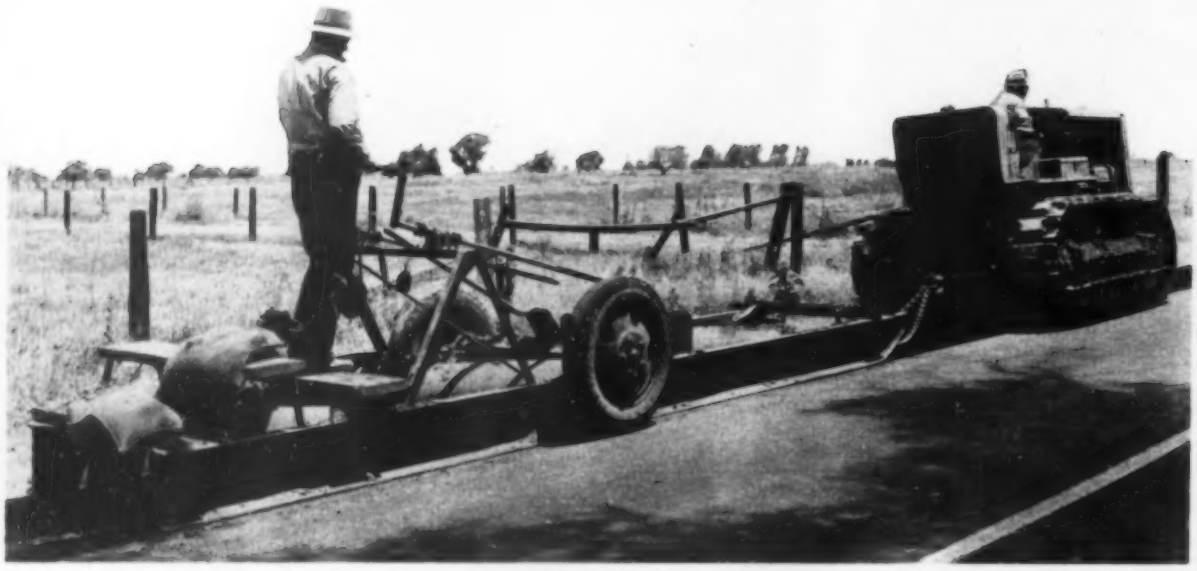
ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE, U. S. A.



5 *Controlled Ignition* **OIL TRACTORS**

DIGGING WISCONSIN OUT

During the storm crisis of last winter, Wisconsin highway officials chose Allis-Chalmers tractors at a ratio of 8 A-C's to 1 of all other makes. This is a typical scene in Fond du Lac county.

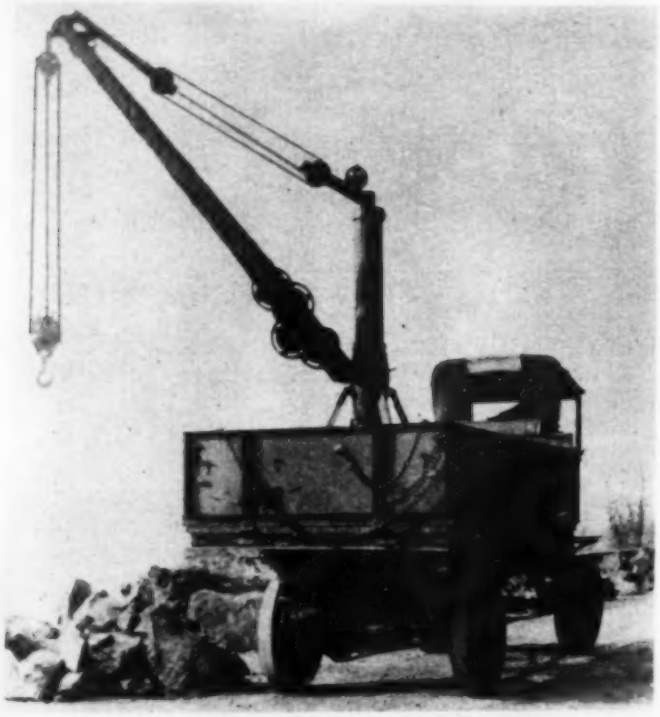


BITUMINOUS SHOULDER

of California pavement *(left)* is mixed in place by six-blade drag, 3½ ft. wide by 12 ft. long, drawn by diesel tractor.—*Photo from Caterpillar Tractor Co.*

Getting Down to DETAILS

Close-Up Shots of Job Methods and Equipment

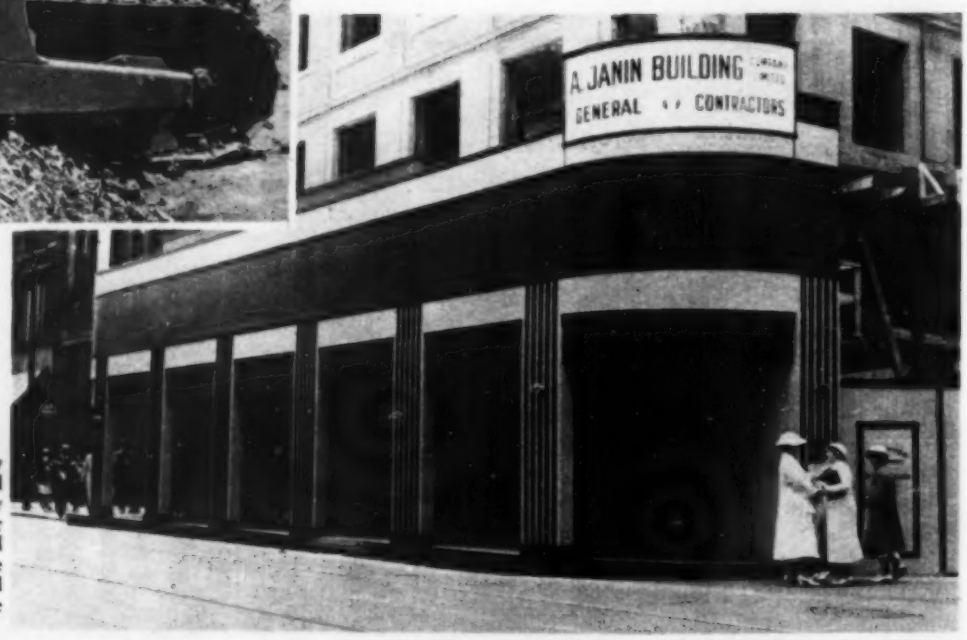


HAND OPERATED DERRICK

full revolving, is mounted on old army truck to set stone for highway guard wall construction along Skyline Drive in Virginia.—*Photo from* G. Y. CARPENTER, *Luray, Va.*

200 MI. OF PIPE LINE

in Cicero, Ill., is backfilled by J. S. Barrett, contractor, of Park Ridge, Ill., with Baker bulldozer mounted on Allis-Chalmers 30-hp. gasoline tractor.



SIDEWALK BRIDGE

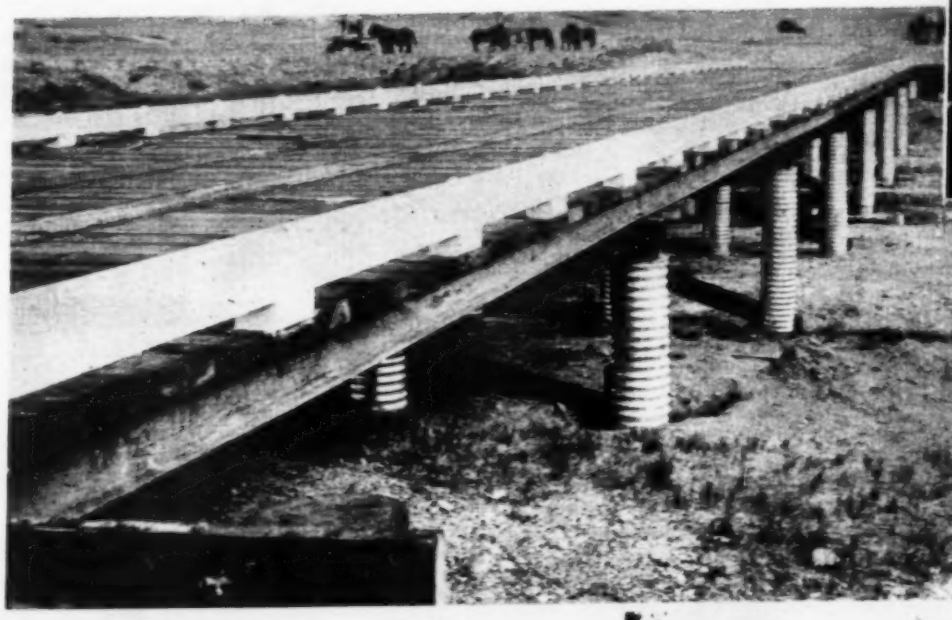
of attractive design *(right)* erected at low cost by Montreal contractor makes judicious use of wood molding and paint to lift it above class of unsightly temporary structures ordinarily knocked together for this purpose. Existing building is being demolished to make way for new five-story reinforced-concrete unit. In Canada sidewalk bridges and fences around construction work are known by old English name of "hoardings".

PAVEMENT WIDENING

in Delaware *(right)* by George & Lynch, of Dover, Del., utilizes paving mixer supplied with dry materials by batch trucks and with water by tank truck carrying portable C. H. & E. triplex pump. Supplementary trailer tanks furnish additional water for main storage and pumping unit. Calcium chloride admixture hastens hardening of 4-ft. widening strip.

CURVED SHIELDS

of corrugated metal plate *(left)* rolled to fit cabs of light trucks used by Irrigation Division of Navajo Service, U. S. Department of Interior, protect cabs and drivers when trucks are being loaded with rock under power shovel dippers. —*Photo from* JAMES D. SEERY, *Project Engineer, Fruitland Project, Fruitland, N. M.*



HOME-MADE RIG

is used by M. Cain Co., Inc., of Washington, D. C., to pour concrete for grade crossing elimination structure on State Route No. 12 near Luray, Va. Outfit consists of old narrow-gage car, bottom-dump concrete hopper, two-cylinder engine from mixer and auto transmission from old Chevrolet car for forward and reverse drive. From mixer each batch is run out on trestle falsework and discharged into chute leading to forms. — *Photo from* G. Y. CARPENTER, *Luray, Va.*

CORRUGATED METAL COLUMNS

filled with concrete and capped with I-beams carry 20-ft. roadway deck across Redwater River in Dawson County, Mont. Well drilling outfit sank Armco 15-in. culverts 8 ft. to sound footing before pipes were filled with concrete. Bents comprising four columns each are sway-braced with 3x12-in. creosted timbers. Decking of 3x12-in. by 20-ft. planks rests on eight lines of I-beam stringers. Bridge, 175 ft. long, has been in service since 1931 with little maintenance expense.

WANTED — Photos of Details

The Editor of Construction Methods wants photographs or sketches illustrating interesting DETAILS of method or equipment and will pay for those he finds acceptable for publication.

Hasn't your job produced some DETAIL that might be illustrated on this page? Send along a picture of it; we'll return it promptly if we can't use it.

EXTRA YARDAGE

in loading and hauling on 30 per cent down grade *(right)* is obtained by Dooling & Son on highway contract near Manville, Wyo., where contractor leaves front apron up during loaded trip and uses 12-yd. scraper as brake pushing about 2½ yd. of pay dirt ahead of unit. Two 12-yd. scrapers operate behind 95-hp. diesel tractors on this project. A 3-hr. time study on one day showed an average of 8.57 trips per hour on 1,400-ft. round-trip haul, working in damp sandstone and brule.

CEMENT PRESSURE GUN

Applies Concrete Continuously

CEMENT PRESSURE GUN lifts sand-cement mixture through rubber hose to height of 125 ft. above street in modernizing Los Angeles department store building. Chutes from working decks on scaffold return rebound to street for remixing with fresh cement. Rebound amounts to about 10 per cent.

A CONTINUOUSLY operating pneumatic pressure gun for application of sand-cement concrete in monolithic structures of any desired thickness has successfully undergone 2 years of proving tests and now is offered for general use by Ed. Westberg, of Los Angeles, who invented the machine, and Walter S. Rae, of Pittsburgh, who improved and refined the original design. Both of these men are active contractors. In their hands the equipment has been applied to the construction and remodeling of buildings and in the repair and construction of walls and bridges. Concrete applied by the new pressure gun is known as "Shotcrete."

Capacity—The cement pressure gun is manufactured in three sizes having capacities of 3, 7 and 12 cu.yd. per hour. To operate these guns air compressors with piston-displacement ratings of 160, 300 and 500 cu.ft per minute are required. The operating pressure at the gun is between 28 and 45 lb., and the normal operating pressure at the compresor is about 60 lb. A 1½-in. rubber hose is used to convey the dry sand-cement mixture from the two smaller units to the nozzle; a 2-in. hose is used for the larger volume supplied by the 12-cu.yd. machine. The pressure guns have shown their ability to deliver the mixture continuously through 500 ft. of hose and at elevations 125 ft. above the machine.

Design—As indicated by an accompanying photograph, the cement pressure gun is equipped with a charging hopper into which a properly proportioned mixture of sand and cement is deposited. A rotary feeding device consisting of five pockets mounted on a rotating shaft transfers the mixture at a uniform rate from the charging hopper to the pressure chamber of the gun, where the sand-cement mixture is assisted toward the outlet by a revolving screw. Agitator blades at the outlet end of this device prevent clogging of the sand-cement mixture at the entrance to the hose. Compressed air is admitted at the agitator through a hole in the feed screw which in turn is connected to the compressor.

Durable and effective air seals which have a long life and which are easily and quickly replaced assure the satisfactory operation of a continuous rotary feeding device for the pressure gun. Two seals are used in the machine, one on the loaded and one on the empty side of rotor travel. Each of the seals consists of a pad of full-floating Para rubber vulcanized to a steel shoe fabricated with four bolts in position for ready attachment to the machine. The surface of the rubber sealing pad is serrated, with the serrations inclined in the direction of rotor travel.

Hard metal parts are used wherever possible in the pressure gun to eliminate wear and reduce replacements. Rotor shaft bearings are machined, but all other metal parts as far as possible are un-machined castings. Equipped with gasoline power units, the three sizes of the cement pressure gun weigh 500 lb., 2,200 lb. and 2,500 lb., respectively. The larger machines are mounted on two pneumatic-tired wheels to facilitate towing.

Because of the continuous operation

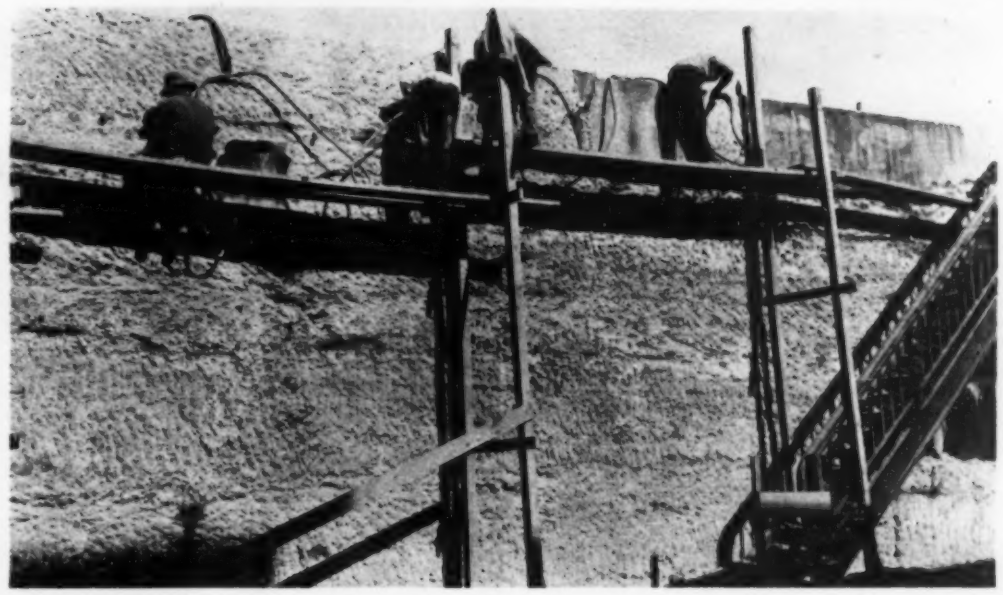
TAUT STEEL WIRES mark edges of wall corners and eliminate need of forms or screed boards. Operator builds up outside wall of orange packing warehouse by placing pressure - applied sand-cement concrete against paper-backed wire mesh.

of the cement pressure gun, plugs in the hose are practically unknown. If a plug does occur, the air pressure in the feed chamber is increased and an automatic cutoff which may be set to function at any desired pressure immediately stops the motor turning the rotor feed. As soon as the mounting air pressure has blown the plug out of the line, the motor can be started again to resume feeding the sand-cement mixture into the pressure chamber.

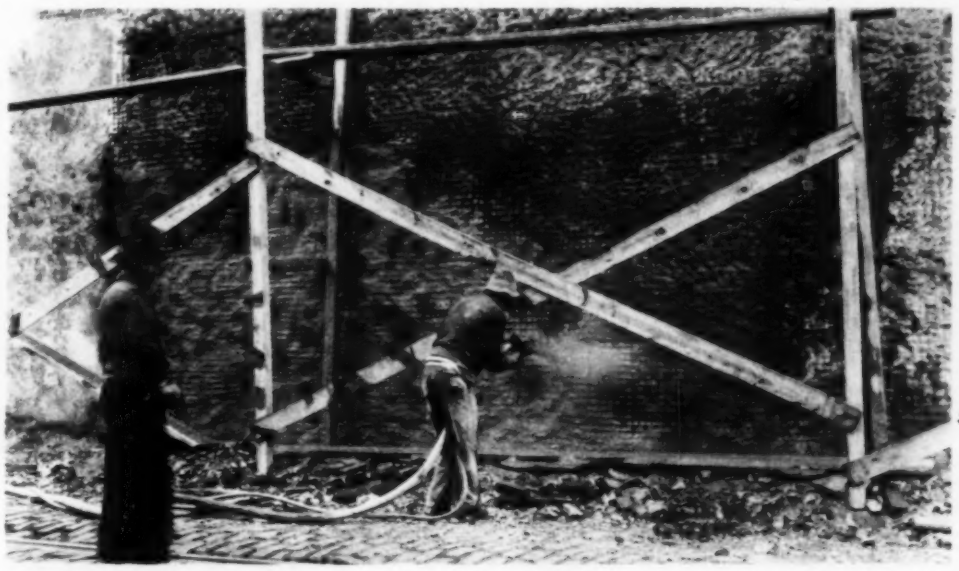
Nozzle—Moisture is added to the sand-cement mixture at the nozzle by means of a water hose connection. A new nozzle design cuts the rebound down to about 10 per cent. A test in the masonry laboratory of the Carnegie Institute of Technology, where the gun was used to build the monolithic concrete walls of a new type of experimental house, indicated that the rebound amounted to between 8 and 9 per cent. In actual construction the rebound is sometimes gathered up and remixed with fresh cement.

Operation—Part-time attention by one man is sufficient to take care of all operating needs of the cement pressure gun and air compressor. In the rare instances when a plug in the hose causes the automatic cutoff to function, a man is needed to start the motor again. Mechanical parts of the machine are designed for long life and quick replacement. The screw feed in the pressure chamber, for instance, has been shown to last through three months of continuous daily operation. This part is speedily replaced by means of a threaded connection to the shaft which rotates it.

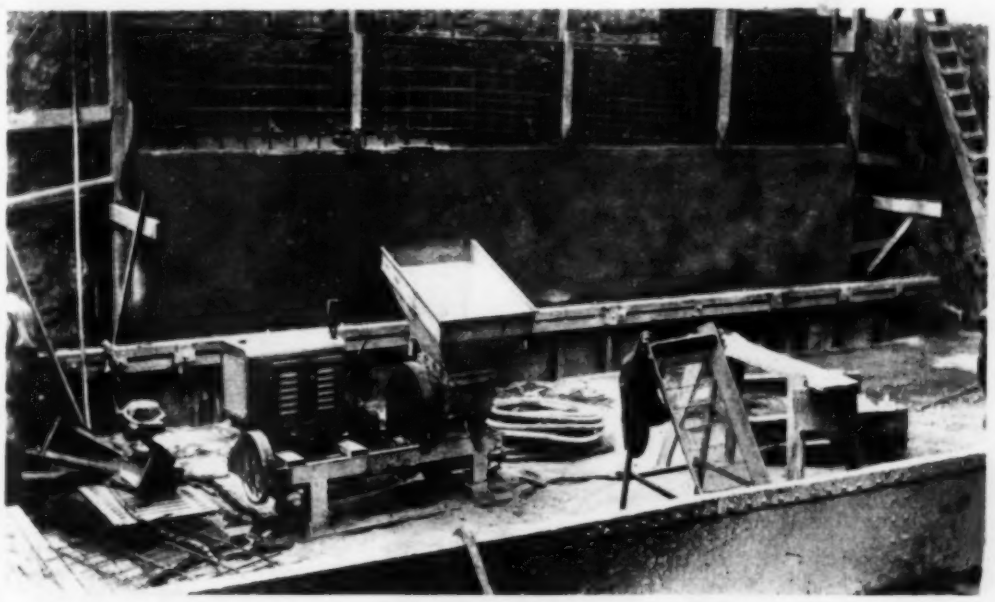
Seals also have demonstrated their ability to last for three months of continuous operation. It is important that seals be replaced as soon as the smallest leak occurs, as a sand blast through even a small leak can in the course of an hour ruin the hard steel rotor. If an extra set of seals is at hand, as they always should be, the replacement can be made in a few minutes, causing practically no delay in the progress of the work. The machines are designed to regulate production by controlling the speed of the rotor shaft. Each size of cement pressure gun is designed with a simple relation between this rotor speed and the number of cubic yards that can be placed in one hour. Thus, for the medium sized unit, which has an ultimate capacity of 7 cu. yd. per hour, the speed of the rotor shaft in revolutions per minute is equal to the production of the machine in cubic yards per hour.



FOLLOWING REMOVAL of disintegrated concrete from bridge wall in Pittsburgh, contractor scores surface to bond heavy coat of pressure-applied concrete.



HEAVY MESH REINFORCEMENT (*right*) is incorporated in new face of bridge wall, applied by cement-pressure gun through rubber hose leading to nozzle. Small hose carries water which is added to mixture at nozzle.



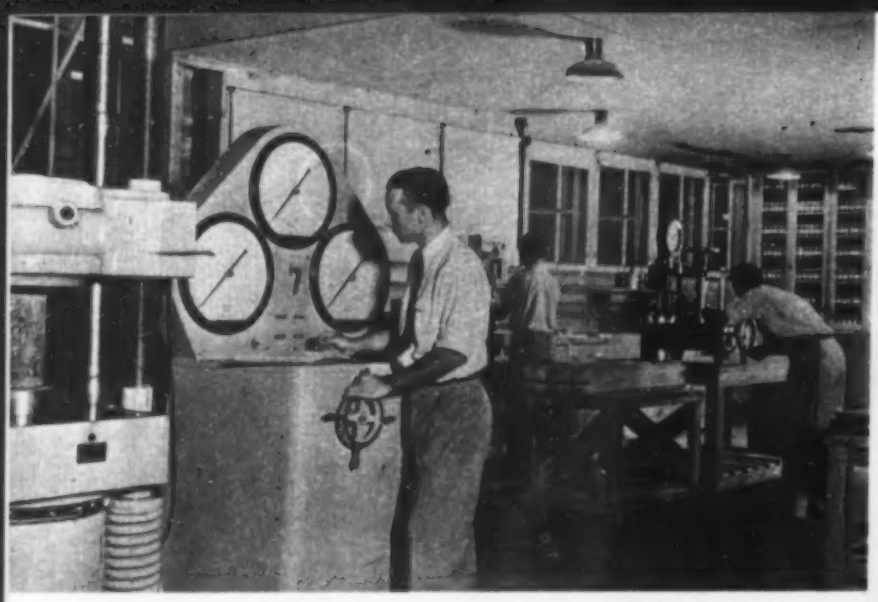
7 CU.YD. PER HOUR (*below*) is capacity of medium-size cement-pressure gun used in adding 30-in. thickness of monolithic concrete to lock wall on Monongahela River. Properly proportioned sand-cement mixture is placed dry in hopper of machine. Rotor feeds dry mixture at uniform rate to pressure chamber.

Building Construction — Sand-cement concrete applied by the new pressure gun was used in the modernization of the J. W. Robinson Co.'s department store, in Los Angeles, described in *Construction Methods*, November, 1934, p. 26 to 29. The pressure gun was utilized likewise in building the concrete exterior walls of an orange packing warehouse for the Placentia Orange Growers' Association in California. In both cases Ed. Westberg, subcontractor for the pressure-applied concrete, placed the "Shotcrete" against a backing of heavy paper reinforced with welded wire mesh.

On one job, Mr. Westberg dispensed with the use of forms in building pilasters and columns, substituting taut steel wire at each break in the surface of the work. With these wires as guides, the fresh "Shotcrete" was screeded to accurate line with steel-edged straight-edges.

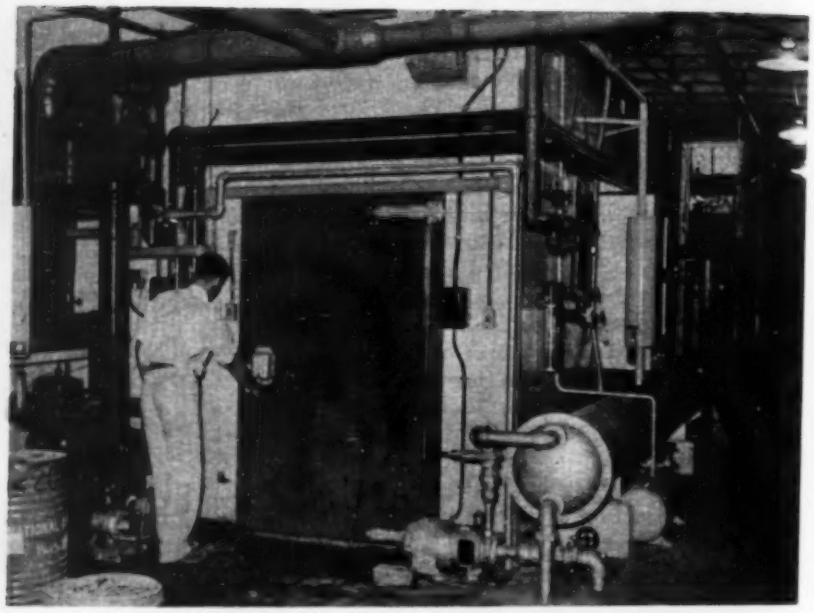
Wall Repairs — For the U. S. Engineers at a Monongahela River lock and for the city of Pittsburgh at the Columbus Ave. Bridge, Walter S. Rae built monolithic reinforced-concrete faces up to thicknesses of 30 in. on old concrete walls after damaged concrete had been removed. At the bridge the contractor also built a parapet wall 4½ ft. high and 21 in. thick at the base, using a form on only one side of the wall as a backing for the "Shotcrete."

Quality of Concrete — Sand-cement concrete applied by the Westberg cement pressure gun is extremely dense and impervious to water. At the Columbus Ave. Bridge, in Pittsburgh, the mixture consisted of one part standard portland cement and five parts sand aggregate, measured by volume. The aggregate was made up of two parts Allegheny River sand and three parts crushed gravel. All the aggregate passed a ¼-in. screen. The City of Pittsburgh made cylinders with the cement pressure gun at this job and broke them at the age of seven days, obtaining strengths at this age ranging from a minimum of 4,103 lb. per square inch to a maximum of 5,570 lb.



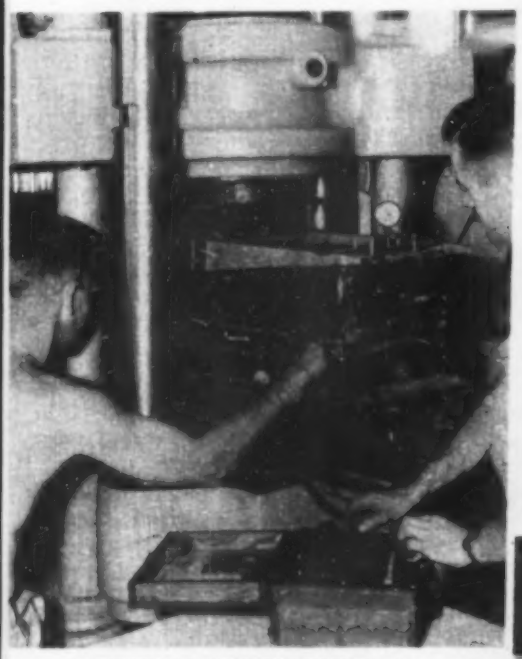
TESTING MACHINES. In foreground is 300,000-lb. Universal testing machine with automatic load control and hydraulic support. This machine tests concrete specimens up to 10 in. in diameter in compression and steel bars up to 5 sq.in. in tension.

TECHNOLOGISTS record meaurements of consolidation-percolation cylinders. After compression has been applied to these specimens in testing machine, nuts are tightened to hold heavy coil springs under constant stress.



"TORTURE CHAMBER" holds concrete specimens subjected to extremes of heat and cold speedily reversed or continued for long periods.

Training School For Construction Inspectors

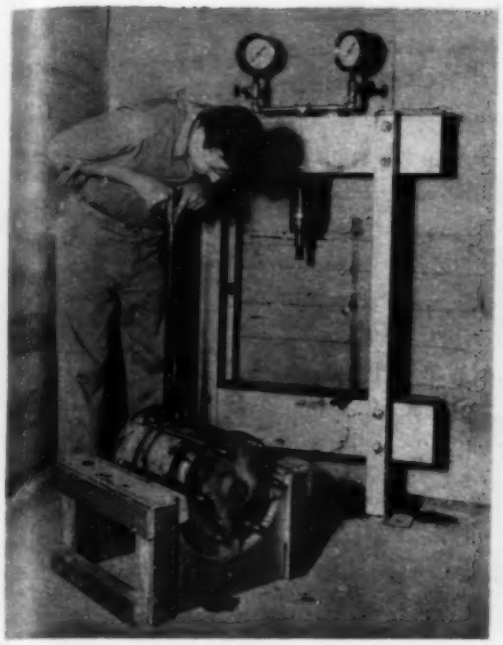


ACCURATE MEASUREMENT of samples is made on large testing machine.

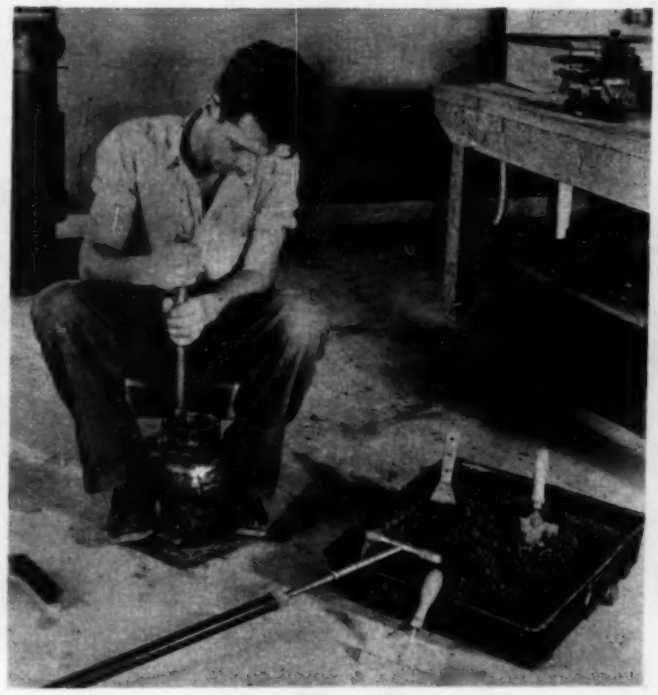
LEWIS H. TUTHILL, *(left)*, testing engineer of Metropolitan Water District of Southern California; "headmaster" of "Banning Tech".

FREEZING AND THAWING TESTS *(right)* are made in cabinet in the foreground. In background men are measuring relative impermeability.

TEST CABINETS line walls of laboratory. Some tests are finished in one day; others require daily observation for long periods.



PLASTICITY NEEDLE TESTS are taken on soil sample in consolidation-percolation cylinder tests.



SOIL SAMPLE is compacted into test cylinder.

REMOVING CORE from cylinder after compaction.

CONCRETE SLAB *(right)* is cast in forms for field test. Small electric vibrator compacts concrete.

WHEN THE Metropolitan Water District of Southern California began active work on the Colorado River aqueduct some years ago, decision was made to centralize inspection and testing activities in a field laboratory. The laboratory was built at Banning, completely equipped with instruments and apparatus for testing and staffed with capable technical assistants. Supervision of the laboratory and of all its activities was put in the hands of Lewis H. Tuthill, still in charge. Because of the effective work he has done, his establishment is known affectionately as "The Banning Institute of Technology." It has turned out many "graduates" who have carried the principles of accurate control into the construction camps scattered along the 300-mi. "front" from the Colorado River to the Pacific Ocean.

Primary purposes for which the laboratory was built and its staff assembled were: (1) To find out what kind of concrete was best adapted to structures along the aqueduct, and (2) to see that this kind of concrete was put into these structures. One of the first requirements was to scour the territory adjacent to the aqueduct for suitable deposits of concrete materials. As a result of these examinations 60 deposits of aggregate materials were developed. With these materials test slabs were made and exposed to wet, dry, cold and hot conditions in the laboratory. A group of 500 concrete slabs was made to get information about relative merits of different cements, coatings and mixtures. Test cylinders were left for months in desert sunshine and then were examined critically.

Since the actual work of construction began on this $220,000,000 job about 260 formal contracts have been made. Routine testing of concrete samples taken on the job is an important part of the laboratory work. The laboratory likewise has tested the bearing value of soils at Cajalco Dam and the relative merits of various patented products. Throughout this work Mr. Tuthill and his staff have acted as a sort of liaison organization between the contractors and engineers of the District at Los Angeles.

When Mr. Tuthill joined the District forces in 1929 he brought with him a background of extensive experience in concrete proportioning and in testing work generally. In his 7 years on the aqueduct he continually has been training testing engineers and inspectors who worked in the laboratory for awhile before being assigned to camps at different parts of the project. The "student body" at "Banning Tech" has varied widely, but a dozen men are required to handle the normal volume of work.

SPRAYING SEALING COMPOUND on field test slabs. Every precaution is taken to prevent influence of one slab on another. Sealing compound is put on sides as well as top.

TEST CYLINDERS exposed to desert sun. Cylinders later will be tested to failure in compression machine.

JOB ODDITIES

A MONTHLY PAGE OF

Unusual Features of Construction

MOVIES IN A SWISS CHALET

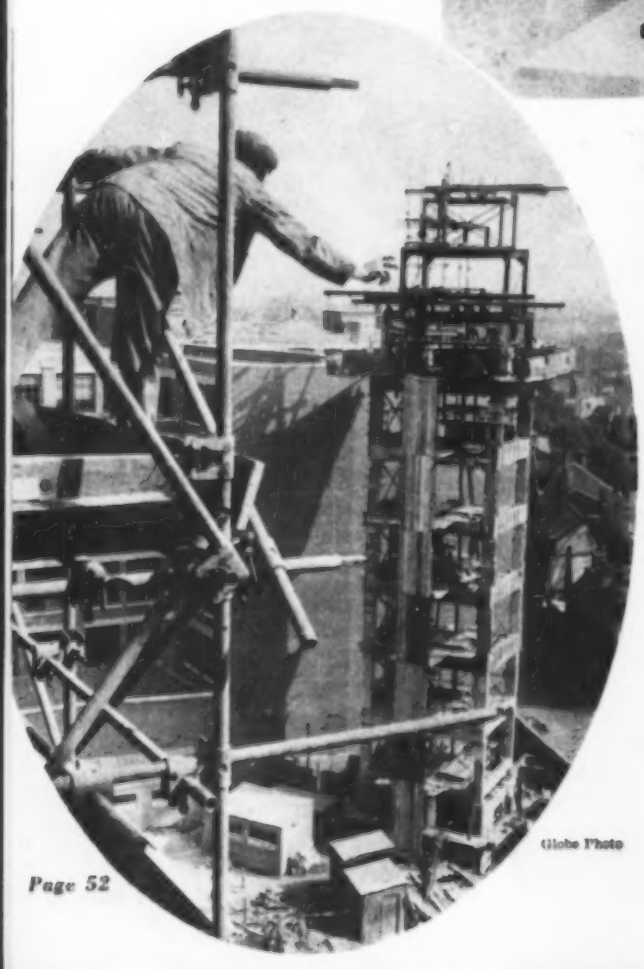
break monotony of camp life for construction workers in town of Fort Peck, Mont., where 7,000 of 10,500 men employed on $50,000,000 PWA project make their homes.

STILL ABLE TO START THINGS

after 150 years. Spade used on Flushing, N. Y., farm when George Washington visited there serves now to break ground for New York World's Fair 1939, commemorating first president's inauguration. Grover Whalen (left), president of Fair, and George W. Pople, president of Flushing Historical Society, grasp oak handle of old spade at ground-breaking ceremony.

SCHOOL FOR SMOKE-EATERS

(*below*) in London, England, is provided by new 120-ft. drill tower at Lambeth headquarters of London County fire brigade.



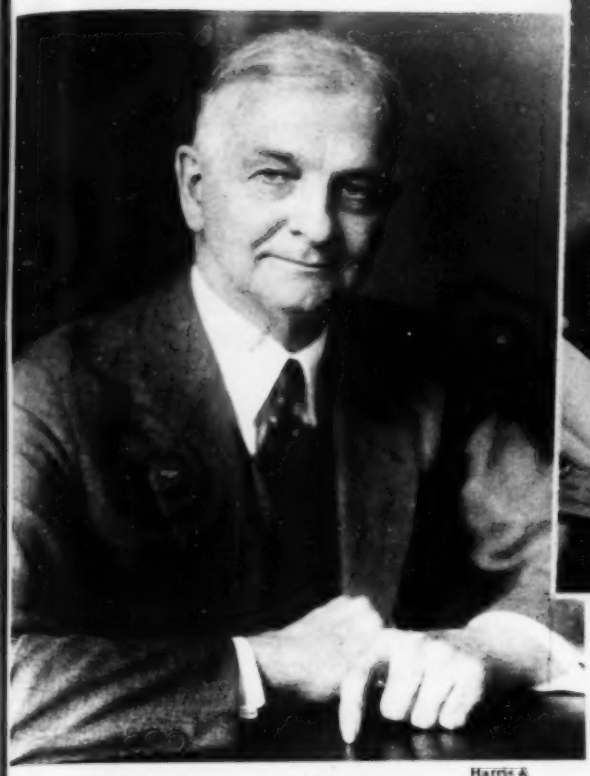
Globe Photo

DWARF TWIN

of Caterpillar four-cylinder diesel tractor, built on 1:6 scale and perfect in every detail, goes on display at New York State Fair, Syracuse, where Richard Young, nineteen-year-old high school graduate of Ithaca, N. Y., and builder of model, points out some features to his mother and father. Latter is tractor salesman. Model weighs 32 lb., in comparison with 9,550-lb. weight of prototype. Tracks alone required casting of 1,054 individual metal parts.

SOME PLUMBER!

Workman (*below*) carries full-size bathtub under one arm and kitchen sink under other into one of new houses being completed on 1,400-acre plot in Markham, Ill., at rate of one a day by Fred J. Walsh, Chicago builder. Briggs Mfg. Co., by developing formed metal plumbing ware which reduces weight of older types by two thirds, makes it possible for single man to carry two large pieces.



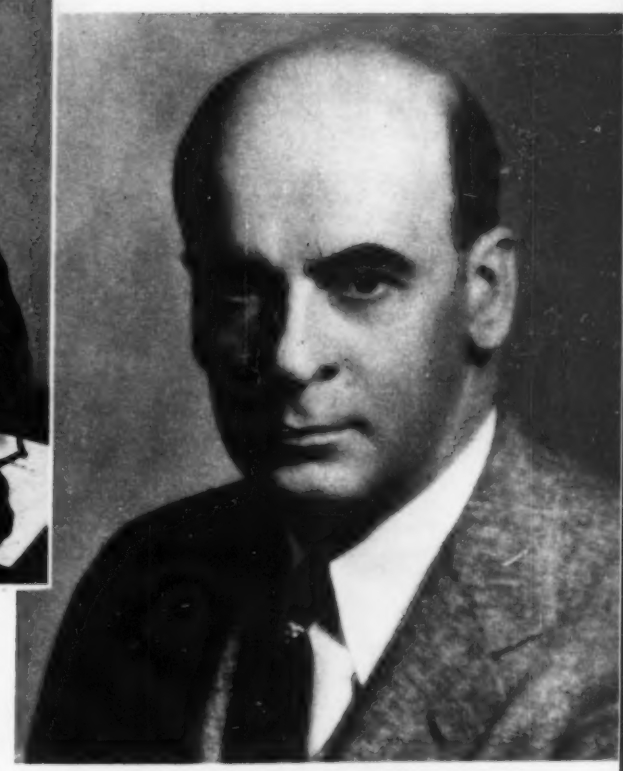
Harris & Ewing Photo

JURISDICTIONAL DISPUTES

on PWA projects are subject to review and arbitration by Dr. John A. Lapp, labor relations director of PWA, recently given authority by American Federation of Labor to settle controversies on which unions involved are unable to reach agreement. All nineteen unions in building trades department of AFL have agreed to accept Dr. Lapp's decisions as final.

QUEENS MIDTOWN TUNNEL

will be built under administrative direction of Col. A. W. Copp, recently appointed general manager of $58,000,000 PWA-financed project by New York City Tunnel Authority. Col. Copp, a graduate of United States Military Academy, was assistant state director for New York State of PWA until his recent appointment. In past he has been associated with several engineering-construction firms.



NEW CHIEF ENGINEER

of Missouri State Highway Department is Carl W. Brown, appointed to this post immediately upon resignation of T. H. Cutler. Mr. Brown, a graduate of University of Missouri and a former railroad engineer and contractor, has been with highway department for 18 years, during last 14 of which he held position of assistant chief engineer.

Present and Accounted For~

A PAGE OF

Personalities

TVA'S GENERAL OFFICE ENGINEER

in charge of central office at Knoxville, Tenn., is Olaf Laurgaard, formerly city engineer of Portland, Ore., and later with U.S. Bureau of Reclamation on construction of Parker Dam.

PWA HOUSING DIVISION

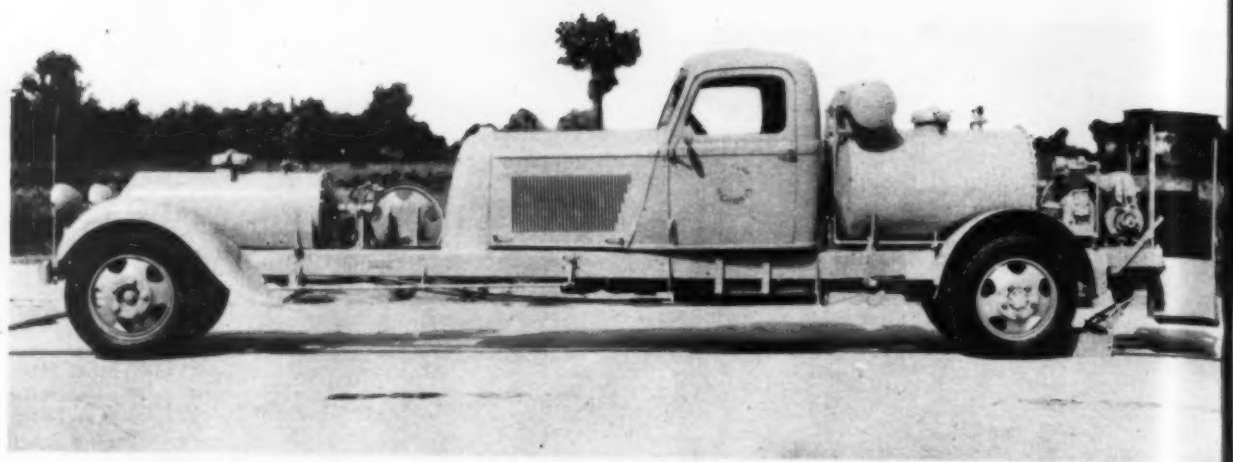
now is directed by Howard A. Gray (*below*) who served as director of Inspection Division of PWA from January, 1934, until recent transfer to new post. Mr. Gray is responsible for operations on PWA housing projects in 35 cities where construction is in progress. Prior to association with PWA he filled executive positions with metal and machine companies.

BUILT-IN SAFETY

in highway construction receives strong support of Dr. H. E. Tabler, chairman of Maryland Roads Commission, recently appointed chairman of Committee on Safe Highways being organized by American Road Builders' Association to promote sentiment throughout country for modernization of hazardous highways.

CENTER-LINE PAINTING MACHINE

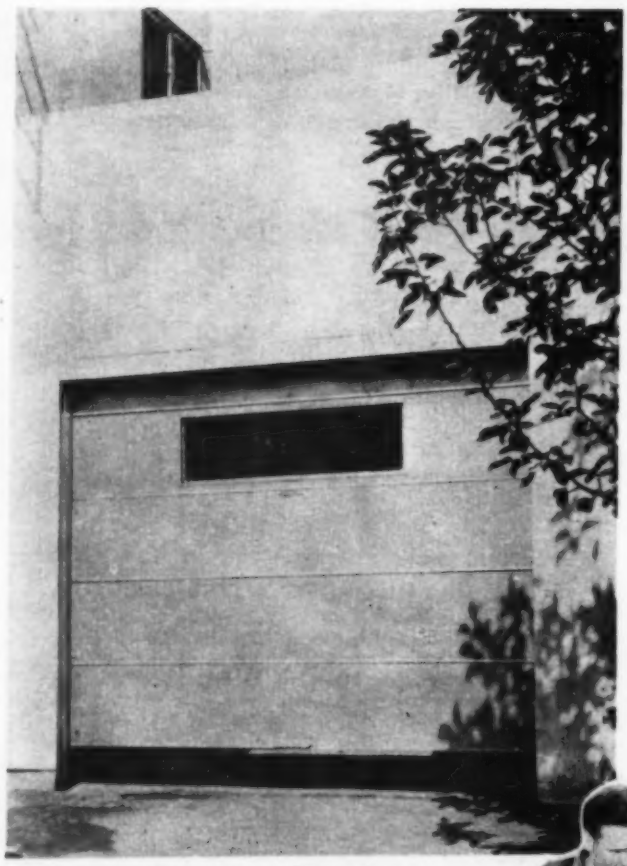
has long wheelbase (19 ft.) and narrow tread (36 in.) *(right)* a combination enabling driver to maintain straight line without preliminary marking on highway and to paint center stripe without interfering with traffic. Driver seated amidships of machine locates center of road by means of triangular sight and communicates with operator at rear using two-way electric signal. Painting is controlled at rear. Marking box can paint 1, 2 and 3 lines, using different colors, if desired. For pigment base painting only, both tanks are arranged with air motor-driven agitators and suitable air-pressure reducing valves, forcing paint to spray box at rear. For black striping rear is equipped with oil burners, and asphaltic paint is delivered to spray box by rotary pump. Chassis propelled by Dodge six-cylinder engine and transmission. Machines used in Indiana paint 40 to 50 mi. per day at $15 per mile.—White Manufacturing Co., Elkhart, Ind.



NEW EQUIPMENT

ELECTRIC SOLDERING IRON

features adjustable, ventilated handle. Lock collar and sleeve make possible adjustment of handle to desired length. Handle also is removable. Compressed pure copper tip of iron accurately machined for valve-fit connection with heating heads assures effective heat conduction and protects metal connecting surfaces from oxidation and flux corrosion. Hermetically sealed heating heads protect "built-in" windings and solid copper cores from air, flux fumes and moisture. Eight sizes from 52 watts with 7/16-in. tip to 435 watts with 1 9/16-in. tip. Each iron has 6-ft. flexible heating cord and metal resting stand.—Stanley Rule & Level Plant, New Britain, Conn.

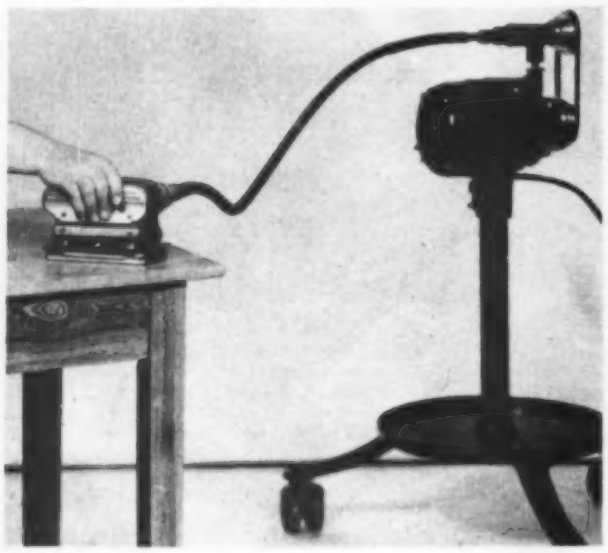


UPWARD ACTING GARAGE DOORS

of new "Float-Over" type (*left*) are recommended where quick, sure and easy operation is desired. Serviceable in private and commercial garages because they slide overhead, taking up no floor, sidewalk or wall space. Three types: (1) 1¾-in. wood doors for standard openings 8x8ft.; (2) 2⅝-in. wood doors for larger openings; (3) tubular all-steel doors. Delicate system of counter balance makes handling of doors easy, but they may be operated inside by push-button, outside by key switch, electric eye, tread switch or other means of remote control. Mechanical operator equipped with safety stop eliminates danger of injury.—Cornell Iron Works, Inc., 3600 13th St., Long Island City, N. Y.

HALF-BAG TILTING MIXER

(*below*) of same general design as large machines used at Boulder Dam, is equipped with spring-mounted axle, Hyatt roller bearings and pneumatic or cushion rubber-tired wheels. Charging height, 34½ in. Can be charged directly through 15-in. drum opening which is in vertical plane, or by a 31-in. wide feed chute available as extra equipment. Drum moves through 40-deg. arc. Power is supplied by 2—2½-hp. Stover inclosed crankcase engine, with oil bath lubrication and magneto. Drive to mixer is through machine-cut gear and pinion. Both gears and engine are inclosed in steel house that can be locked.—T. L. Smith Co., 2835 N. 32 St., Milwaukee, Wis.



PORTABLE ELECTRIC SANDING

and rubbing machine (*left*) is able to do effective work on curved and flat surfaces of metal fabric, wood, composition, leather and marble because of specially constructed "floating" block. This block contains three flexible rollers of special composition rubber and fabric which are attached by pins to sander block, assuring no restriction in movement of block when sanding and finishing. Sanding action reciprocal with ⅜-in. travel of sanding pad at speeds from 1,750 to 2,800 complete oscillations per minute. Designed for wet and dry sanding. May be operated from any electric outlet, either 110 or 220 v.—Sterling Products Co., Detroit, Mich.

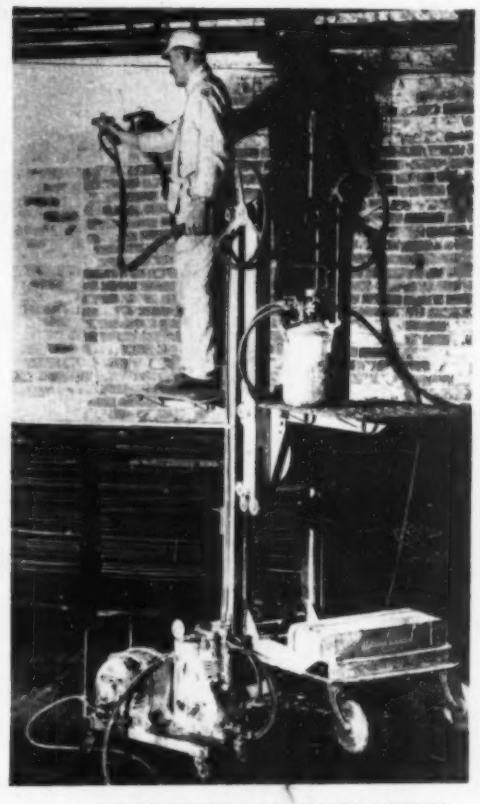
••• On the Job

10-YD. WAGON SCRAPER

built for use with 75-hp. and larger tractors, is especially designed for digging, loading, hauling and dumping tough clays and gumbo soils, shales, hard pan and rocky soil as well as loams and sandy clays. Built of "dynamic" heat-treated alloy castings and alloy heat-treated shafts. Digging bucket, patented front apron and rear dump door are fabricated of special steel plate, arc welded into one-piece units. Hydraulic power-control unit consists of heavy-duty hydraulic pump, free working control valve and rear type control lever providing fingertip control by tractor operator. Overall length, 16 ft. 9 in.; width, 11 ft. 9½ in.; height 6 ft. 9 in.—Continental Roll & Steel Foundry Co., East Chicago, Ind.

PORTABLE PAINT SPRAYER

medium size outfit (*below*) for both interior and exterior painting and for light-duty touch-up and refinishing work. Unit consists of ½-hp. electric motor, air compressor unit, 2-gal. capacity pressure tank, standard bleeder-type spray gun with adjustable nozzle and various lengths of rubber hose. Mounted on wheel base. Weight, 180 lb. Equipped with two-cylinder, air-cooled-type compressor with 2¼-in. bore and 1¾-in stroke (working pressure, 45 lb.); air pressure regulator and gage; safety valve set for 60-lb. pressure. Gasoline motor (½-hp.) may be used if electricity is not available.—Binks Mfg. Co., Chicago, Ill.

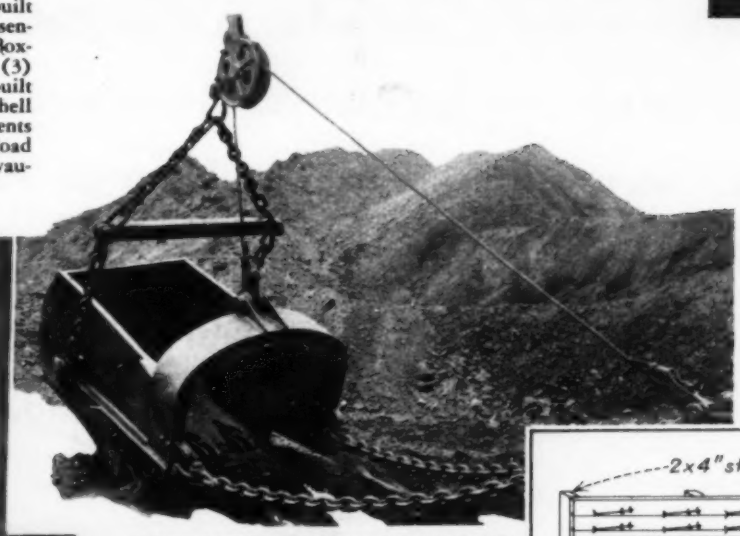


SAFETY GOGGLES

have as additional feature side shields *(right)* providing extra protection against particles striking from any direction. Wire mesh screens are non-corrosive and easily cleaned. Fine enough to prevent passage of flying particles but not to hinder air circulation. Metal frame also non-corrosive. Equipped with usual safety and comfort devices of regular Ful-Vue goggles, such as high-up end pieces, self-adjusting nose pads, and six-curve super armor-plate lenses.—American Optical Co., Southbridge, Mass.

ALL-WELDED DRAGLINE BUCKETS

in sizes *(right)* from ⅜ to 4 cu.yd., are built to handle jobs where ruggedness is first essential and have following features: (1) Box-construction arch; (2) all-welded design; (3) reversible and renewable tooth points; (4) built of high tensile alloy steel; (5) one-piece shell construction. Balance built into bucket prevents it from tilting with consequent loss of load while hoisting.—Harnischfeger Corp., Milwaukee, Wis.

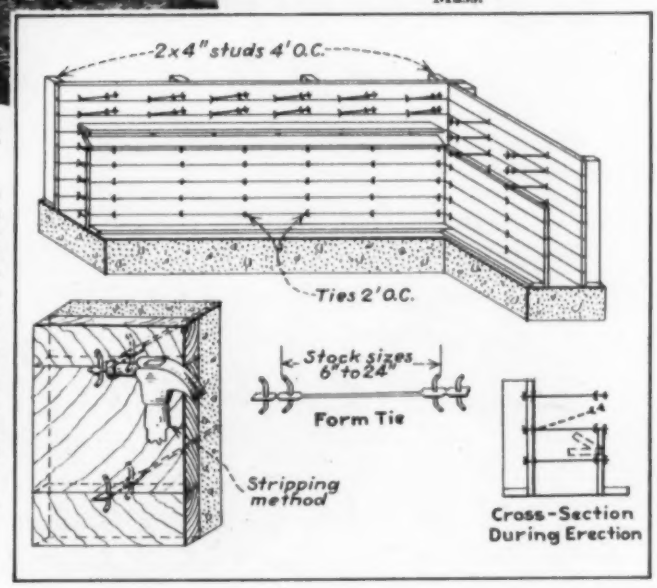


PORTABLE ROTARY FLOOR EDGER

has heavy-duty 1¼-hp. motor which drives 7-in.-diameter rubber combination pad to which paper or cloth-backed abrasive disks may be attached. Machine (*left*) handled by two easy-grip handles mounted on sides at proper height to clear nosings and stair treads when resurfacing steps. Aluminum apron extension provides vacuum system for picking up dust. Hardened steel, chrome plated guard surrounds revolving disk to prevent marring of baseboards or other upright objects against which edger comes in contact. Complete abrasive disk-cutting outfit supplied as standard equipment.—Porter-Cable Machine Co., Syracuse, N. Y.

ECONOMICAL FORM TIES

which eliminate wales and require studs on 4-ft. centers on one side only in wall construction (*below*) reduce labor of form erection and stripping and effect great saving in materials. Manufacturer suggests use of 6-in. or 7-in. square-edged boards with one tie for every square foot of wall. Actual cost figures on many jobs show savings as great as 30 per cent in form construction. Stripping is done by tap with hammer, breaking off head of tie slightly beneath surface of concrete and leaving clean wall. Lumber salvage is almost 100 per cent.—Perfect Form Tie Mfg. Co., 2333 Enterprise St., Los Angeles, Calif., and Bay State Builders Supply Co., 50 Landsdowne St., Cambridge, Mass.



"VENTUBE" SCORES A BULL'S-EYE IN LOW COAL

And what, you ask, has low coal got to do with your problem of pushing a tunnel through a mile of solid rock?

Simply this. In low coal the flexible ventilating duct is many times simply placed on the ground. Concussion in a working where the height is not over 48" is savage and destructive. The unsecured tubing takes a tougher beating than in any other use. And Jute du Pont "Ventube" is the established standard in low coal mining.

Jute "Ventube", equally strong in both directions of the weave, is built to take it under all mining and tunnelling conditions.

DU PONT
VENTUBE

The Flexible Ventilating Duct

E. I. DU PONT DE NEMOURS & CO., INC., *Fabrikoid Division*, Fairfield, Connecticut

5 REASONS *why* DUMP TRUCK OPERATORS SAVE MONEY WITH HIGH PROFILE GOODYEARS

1 Goodyear's All-Weather Tread is even broader, flatter—has deeper-cut diamond blocks that give better grip, pull, traction and non-skid protection.

2 Patented pre-shrunk Supertwist Cord, far more elastic than ordinary cords, gives body greater strength, reduces flexing heat, adds thousands of miles to tire life.

3 High Profile Tread Shape increases flexing zone, dissipates heat more readily, provides better cushioning—puts more rubber on ground.

4 Extra-strong Braided Wire Beads protect against swaying loads and overloads, insure firm seating of tire on rim.

5 Chemically Toughened Rubber in both tread and body resists both tread wear and heat—protects against blow-outs.

More miles of tire life—*thousands more*—mean but one thing to truck operators—LOWER TIRE COSTS!

But you get BOTH—and more, too—in the new High Profile Goodyear for trucks.

Bigger, sturdier, tougher—you'll find this tire better in every way on the job—better in traction, in cushioning, in driving.

And it's safer. It gives you protection against both skidding and blow-outs—against carcass failure of any kind—not equalled in any other tire.

Why this amazing *plus performance?*

Because only Goodyear—in this new High Profile Truck Tire—offers you the five money-saving, *plus construction features* opposite.

Read them. See the tire. SAVE MONEY!

THE GOODYEAR TIRE & RUBBER COMPANY, INC., AKRON, OHIO

GOODYEAR

TRUCK TIRES *money savers*

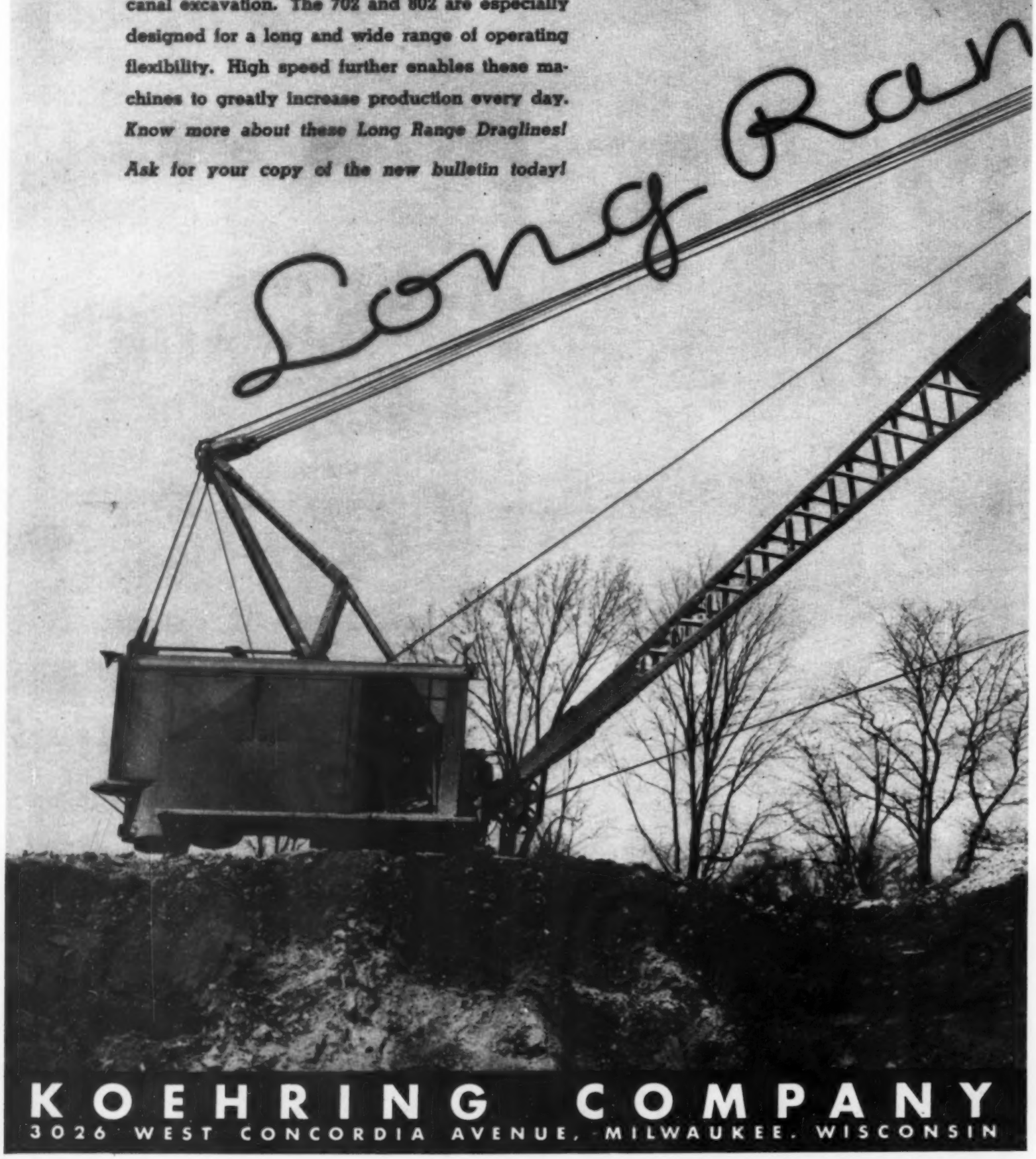
There's a GOODYEAR BATTERY *now!*

KOEHRING

Two new KOEHRING *Long Range* DRAGLINE models for large drainage projects, extensive stripping areas in mines and quarries and wide canal excavation. The 702 and 802 are especially designed for a long and wide range of operating flexibility. High speed further enables these machines to greatly increase production every day.

Know more about these Long Range Draglines!

Ask for your copy of the new bulletin today!

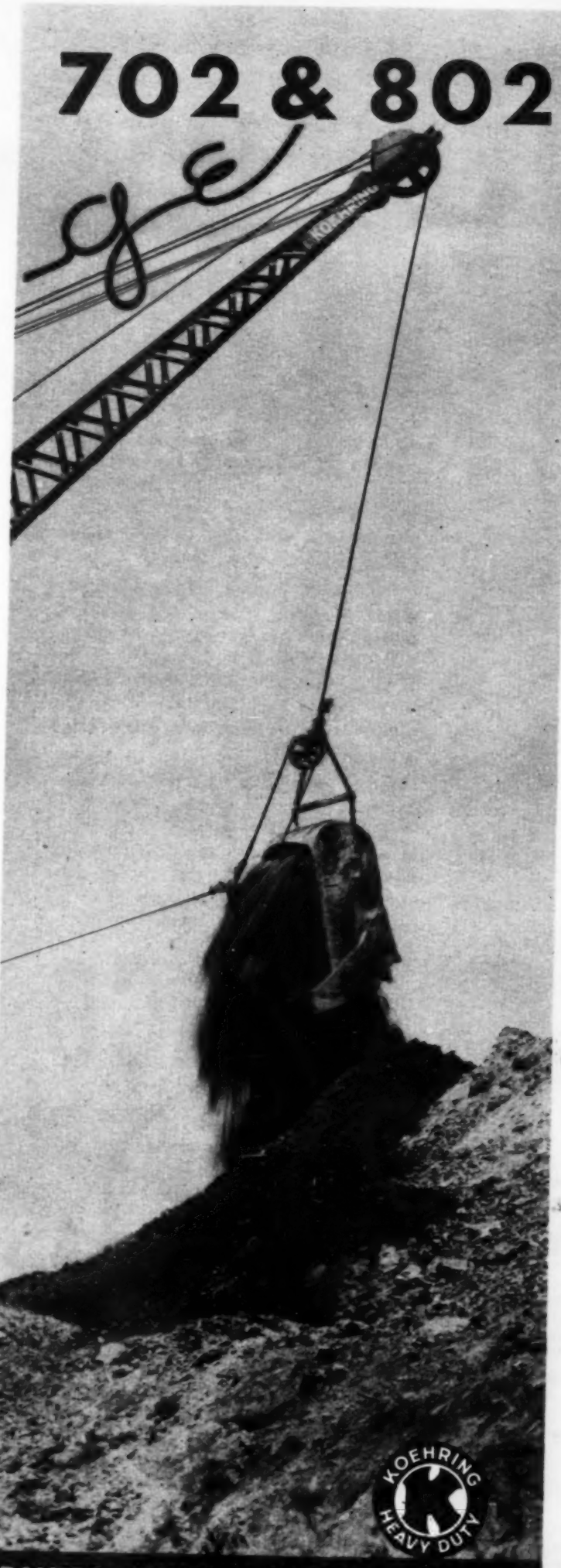


KOEHRING COMPANY

3026 WEST CONCORDIA AVENUE, MILWAUKEE, WISCONSIN

702 & 802

ge



PAVERS • MIXERS • SHOVELS • CRANES
DRAGLINES • DUMPTORS • MUD-JACKS

MORE TRENCH

(five to one on this job)

A Moretrench Wellpoint System, properly installed, can lower ground water levels under any condition. Experience on thousands of successfull installations will tell us how to dry your job. A dry job insures a quick start and — *generous estimates always follow Moretrench.*

MORETRENCH CORP.
Sales and Rental Office:
90 West Street, New York
Works:
Rockaway, New Jersey

New CMC "DUMPOVER" PNEUMATIC TIRED CART

EASY WHEELING

NO HOEING
NO
SHOVELING
NO BUMPING

STANDARD
SIZE
BALLOON
TIRES
OBTAINABLE
ANYWHERE

EASY DUMPING

ONE MAN WHEELS AND UNLOADS TWICE AS MUCH!

The biggest improvement in cart construction in years. Dynamometer tests prove it takes only *half* the force to move the CMC "Dumpover". Exclusive chassis construction with perfectly balanced tray enables operator to unload cart completely without lifting wheels or chassis. 3 sizes — 6½, 9 and 11 cu. ft. Write for bulletin.

Get latest bulletins on CMC Wonder, Master and Silverstreak Mixers — all sizes. Wheelbarrows, hoists, pumps and saw rigs.

CONSTRUCTION MACHINERY CO.
Waterloo, Iowa

ANOTHER 10-MILE LINK
in NEW YORK STATE'S HIGHWAY SYSTEM

TOP: Machine-spreading TEXACO Asphaltic Concrete mix (cold laid type) on 10 mile New York State highway in Chautauqua County.

CENTER: Compacting the ribbon of TEXACO Asphaltic mix laid down by the machine spreader.

BOTTOM: View of the completed surface, showing its safe, skid-proof texture.

Again New York State increases the mileage of cold-laid TEXACO Asphaltic Concrete on its State Highway System. A 10-mile section of this durable, skid-proof, economical surface has just been completed in Chatauqua County.

From widespread experience on hundreds of miles of its State Highway System, New York has proved to its complete satisfaction the ability of this TEXACO Asphaltic surfacing to stand up under severe traffic impact and to provide maximum safety under all weather conditions.

In the wide variety of road and street surfaces made available by TEXACO Asphaltic products, the public official will find a completely satisfactory answer to his particular needs. Why not discuss matters with an experienced TEXACO Asphalt specialist?

TEXACO

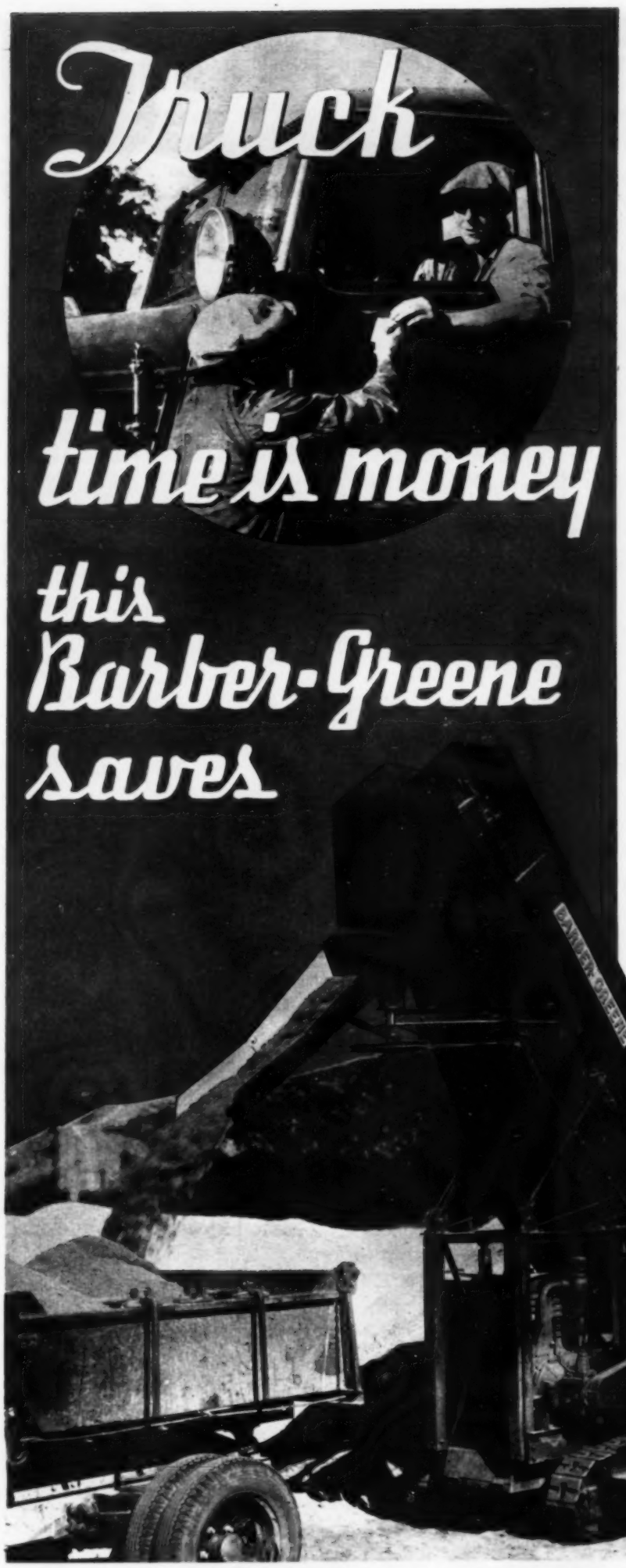
TEXACO
REG. T. M.

ASPHALT

THE TEXAS COMPANY, Asphalt Sales Dept.

135 East 42nd St., New York City

Buffalo	Cleveland	Houston
Chicago	Richmond	Jacksonville
Philadelphia	Kansas City, Mo.	Dallas
	Boston	



IF you haven't carefully checked your itemized costs, you'll probably find "Truck Time" one of the biggest leaks in your job system.

Barber-Greene Model 82 Loaders have often made it possible to reduce the number of trucks. On other jobs truck time savings paid for the loader before the job was half done. A loader that's rated at 2 to 3 yards a minute—has been clocked at 4—doesn't take long to load your biggest truck—can't cause appreciable truck waiting.

Consider your present loading system from this important angle—and then consider the many superior features of this Barber-Greene Loader: Synchronized Feeding, Tank Type Chassis Frame, Automatic Overload Release, Super Maneuvering, Slow Crowding, Parallelogram Oscillating Axle, and many others.

A card will bring complete details—there is no obligation.

36-31

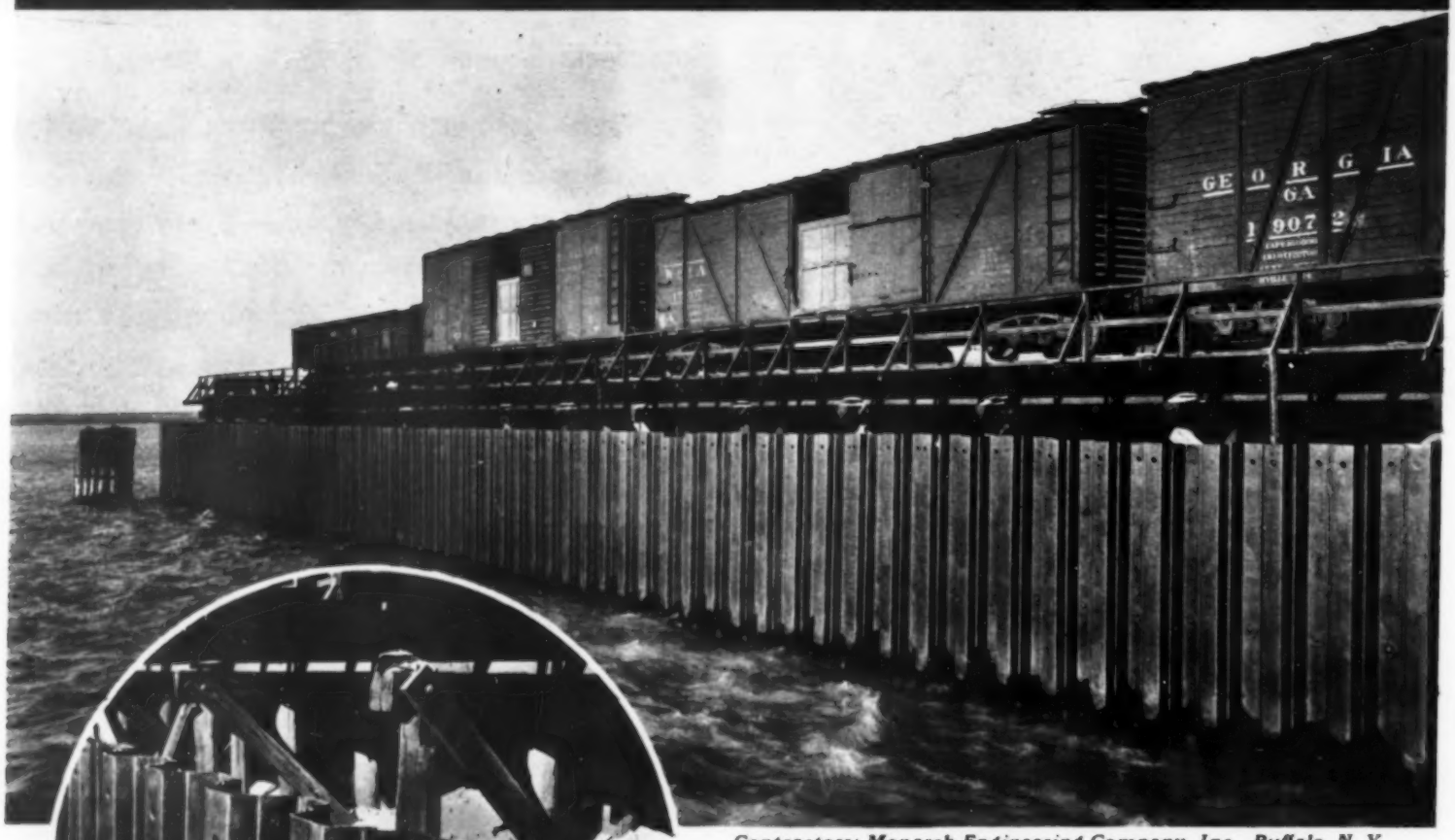
BARBER GREENE

BARBER-GREENE COMPANY

530 West Park Ave., Aurora, Ill.

STANDARDIZED MATERIAL HANDLING MACHINES

BETHLEHEM *Steel Sheet* PILING



Contractors: Monarch Engineering Company, Inc., Buffalo, N. Y.

Used in repairing Harbor Trestle

THE Canadian Pool Terminal's trestle in Buffalo harbor had been weakened by the action of the water and ice. Repairs were frequent and expensive; insurance rates high. As an economy and safety measure it was decided to make no more partial repairs to the trestle but to restore it by enclosing it completely in a bulkhead of Bethlehem Steel Sheet Piling.

Approximately 250 tons of 30- and 40-ft. steel sheet piling were used in completing the project. The interior of the bulkhead was filled to the water level with sand and gravel.

Bethlehem Steel Sheet Piling is particularly well adapted to this type of pier and trestle reconstruction work. Its use eliminates the necessity for extended shutdowns of the structure being repaired and all operations can be completed with minimum delay.

The economy and efficiency of Bethlehem Steel Sheet Piling have led to its widespread use in the construction of cofferdams, in canalization work, in permanent cut-off walls, and in other projects involving the retention of earth or water. Bethlehem engineers will gladly cooperate in the preparation of designs involving steel sheet piling or submit suggested designs.

BETHLEHEM STEEL COMPANY, *General Offices:* Bethlehem, Pa. *District Offices:* Albany, Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Hartford, Honolulu, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Portland, Ore., Salt Lake City, San Antonio, San Francisco, St. Louis, St. Paul, Seattle, Syracuse, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

SMITH

15 FEET LESS HEAD ROOM

BECAUSE OF SMITH FRONT END CHARGING!

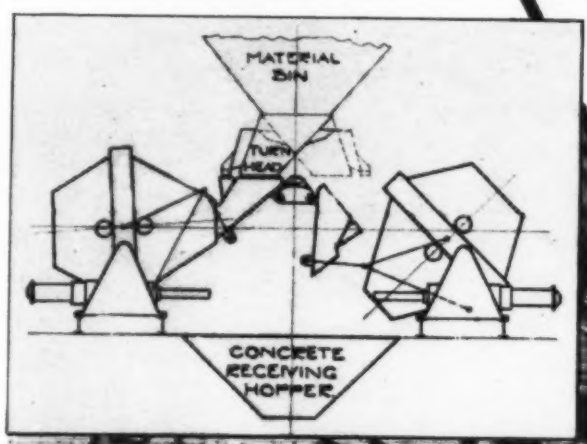
IN building the new Tygart Valley Dam, the contractors, Frederick Snare Corporation, wanted an unusually low head room mixing plant. Four Smith three-yard Tilters, arranged for FRONT END CHARGING, easily met the requirements and are now pouring concrete on a fast, big production basis.

The mixers are charged and discharged thru the SAME drum opening. A single batching plant feeds all four mixers, and a single hopper receives the mixed concrete. FRONT END CHARGING actually saves about 15 feet in head room—requires materials to be elevated about 15 feet less than otherwise—reduces plant construction costs—saves time in loading because of shorter distance between bin and mixer opening. Practically no back tilt required. Famous Smith "End-to-Center" mixing action is retained.

Conceived by Smith Engineers several years ago, FRONT END CHARGING is now proving highly successful on big jobs. Write for further data.

THE T. L. SMITH COMPANY
9851 N. 32nd St., MILWAUKEE, WISCONSIN

Note compact set-up due to FRONT END CHARGING. Aggregates enter drum in practically straight line.



SMITH MIXERS

THE BOULDER DAM MIXERS

10 REASONS WHY

ARMCO STEEL PLATE LININGS

• *Note the many features of this plate section. When you see this exclusive Built-in-Rib design in underground construction you KNOW it is Armco Structural Steel Plate Lining.*

★ **EXCLUSIVE BUILT-IN-RIB DESIGN**

Provides uniform strength at every point. Gives you a truly balanced construction.

★ **NO WEAK JOINTS** *Full-length* corrugations make the lapped joints as strong as the plate.

★ **POUND FOR POUND IT'S THE STRONGEST PLATE**

Greater strength with far less weight. Lower in first cost. Easily and quickly handled for installation.

★ **LESS STRUCTURAL REINFORCEMENT**

The ribs in the plate for strength and economy. Eliminates one operation. Saves up to 50% on labor costs.

★ **GOES IN FAST**

Less excavating work. No cutting or fitting required. Interchangeable plates. Delivered fitted for installation. Bolted construction.

★ **BETTER ALL-ROUND JOB**

Reduced fire hazards. Better line and grade. Meets specifications fully.

★ **TESTED AND PROVED**

Thoroughly tested in laboratory. Proved in actual service.

★ **FOR ALL TYPES OF UNDERGROUND CONSTRUCTION**

Tunnels. Caissons. Sewers. Conduits.

★ **BACKED BY ARMCO**

The manufacturing and engineering facilities of Armco are your assurance of correct fabrication and prompt delivery.

★ **SPECIALIZED KNOWLEDGE AT YOUR DISPOSAL**

Valuable data gained from long experience and constant research are yours for the asking. Armco engineers are always ready to assist in the solution of difficult problems in underground construction.
For information as well as definite figures on that next job write to Ingot Iron Railway Products, Middletown, Ohio • Berkeley, California

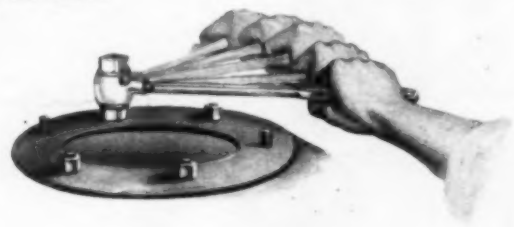
ARMCO

STEEL PLATE LININGS

NO TIME LOST
IN THE TURNING OF NUTS
IF YOU USE THE FAVORITE
REVERSIBLE RATCHET
WRENCH

EACH HEAD CAN TURN TWO DIFFERENT-SIZED NUTS

This is a great saving over ratchet wrenches that turn only one nut in each head, as it means fewer parts to keep on hand.



WORKS ON A QUICK STRAIGHT-AHEAD RATCHET MOVEMENT

The new metal now used in Handles, Heads and Pawls enables the "Favorite" to stand up under harder and rougher usage. Ratchet movement eliminates all lost motion. Does not leave the nut until operation is completed.

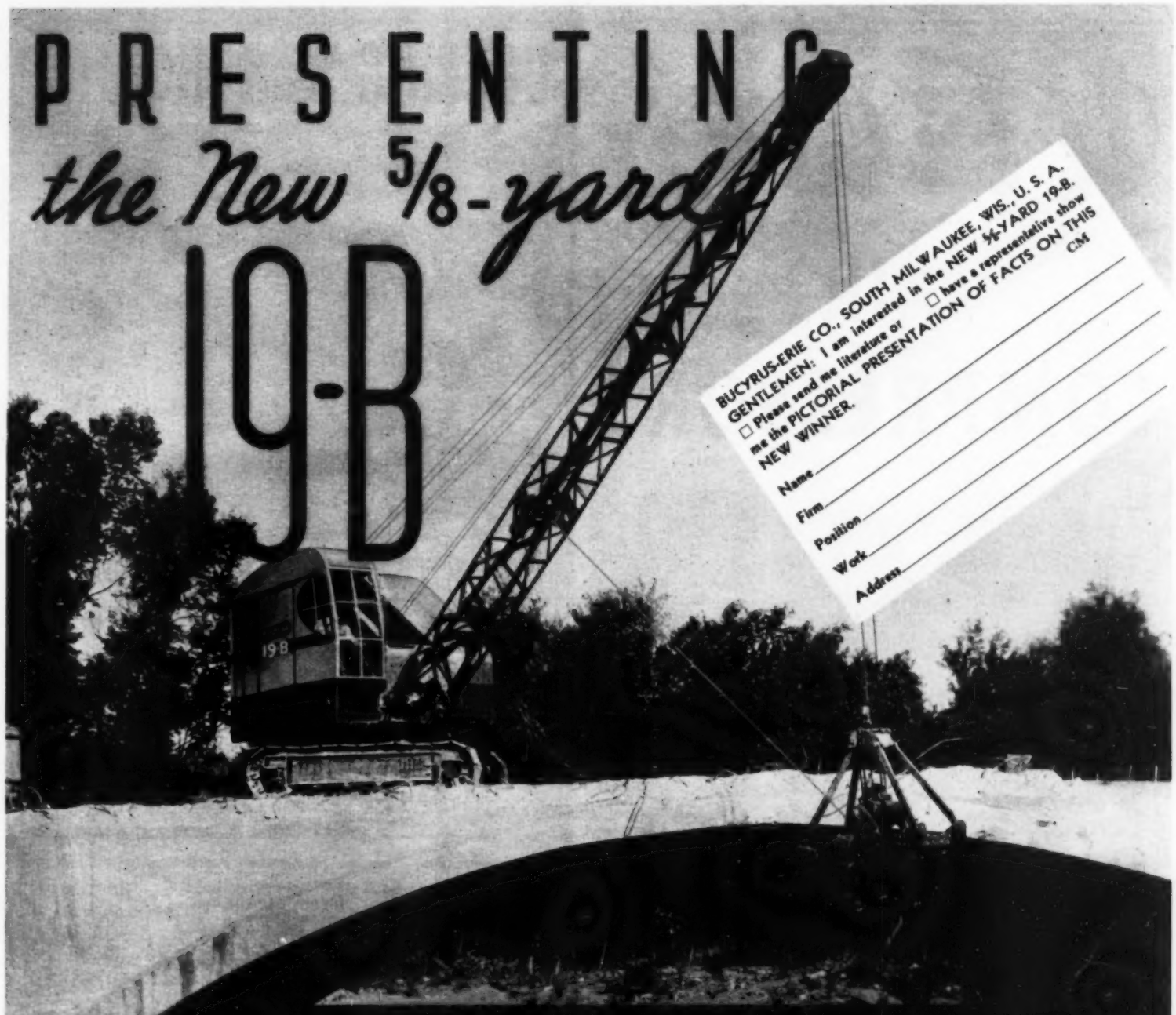
A TIME-SAVER

Can be used in narrower places than an ordinary wrench. Each head can turn two different-sized nuts—one in each end. Opening in head allows bolt to pass clear through.

SEND FOR FULL PARTICULARS

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 DUANE STREET NEW YORK, N. Y.

PRESENTING
the New 5/8-yard
19-B



BUCYRUS-ERIE CO., SOUTH MILWAUKEE, WIS., U. S. A.
GENTLEMEN: I am interested in the NEW ⅝-YARD 19-B.
☐ Please send me literature or ☐ have a representative show me the PICTORIAL PRESENTATION OF FACTS ON THIS NEW WINNER.
CM

Name_____
Firm_____
Position_____
Work_____
Address_____

Big Brother to the WORLD FAMOUS 10-B

The new 19-B is modern in appearance, modern in design, modern in performance . . . weighs only 16 tons; is fully convertible, all types of front-end equipment available; travels 1¾ M.P.H.; swings 4¾ R.P.M. on hooked, conical rollers; has 37 anti-friction bearings; automatic lubrication; gas or Diesel power.

Find out all about this new ⅝-yard winner today. Write:

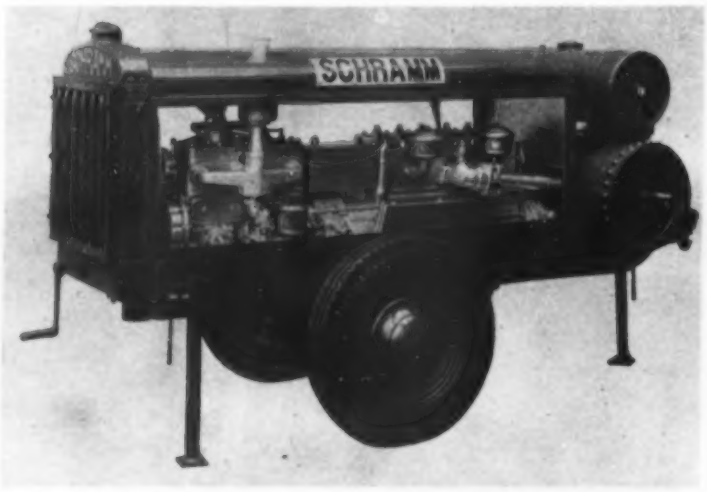
BUCYRUS ERIE

BUCYRUS-ERIE

EXCAVATING, DRILLING, AND MATERIAL HANDLING EQUIPMENT... SOUTH MILWAUKEE, WISCONSIN, U.S.A.

Utility

AIR COMPRESSORS



SAVE MONEY

in transportation costs

Because the new, modern SCHRAMM "Utility" is the lightest PORTABLE compressor ever known. Weight reductions as great as 50% over other types—by adopting modern automotive engineering principles. Saves time in moving on the job—quicker transportation. Less man power to move. Smaller trucks for hauling. SAVINGS NEVER BEFORE KNOWN TO THE CONSTRUCTION INDUSTRY.

Sizes 105, 210, 315 and 420 cu. ft. actual air delivery. Gasoline or Diesel powered. Write for new bulletin 3652-C0.

SCHRAMM

INCORPORATED

WEST CHESTER, PA.

COFFING ADVANCED DESIGN HOISTS

COFFING HOIST CO.

LIGHT • COMPACT • PORTABLE • POWERFUL

DON'T TAKE OUR WORD FOR IT

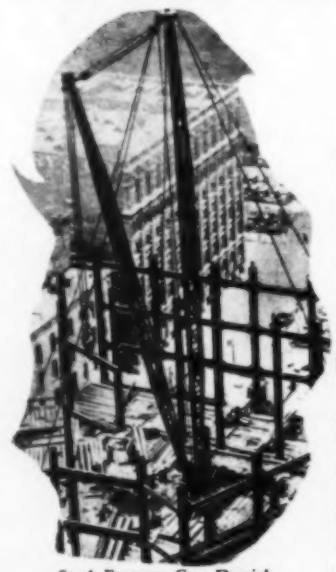
We'll gladly arrange for you to try these one man powerful ratchet hoists and prove for yourself the abuse they'll take. They'll lift or pull heavy pipe or machinery, heavy cable and do hundreds of other jobs. The final test on all furnished units is 100% over rated capacity! Built from ¾ to 6 tons capacity, weight 14 to 65 lbs. Write for Catalog.

COFFING HOIST COMPANY

DANVILLE ILLINOIS

TRADE MARK DOBBIE ESTABLISHED 1862

All Steel DERRICKS



Steel Erectors Guy Derrick, with Ball Bearing Footblock.

Guarantee Safety

When you guarantee safety, you economize — for safety means uninterrupted operation and lowest possible maintenance costs.

And DOBBIE All-Steel Derricks have been designed for safety and consequent economy. They have a safe load capacity of almost twice their rating. You need this assurance of dependable safety and continuous performance.

SAVE POWER BY USING BALL OR ROLLER BEARING FOOTBLOCKS AND SHEAVES. Built in both Guy and Stiff-leg types. Write for information and prices.

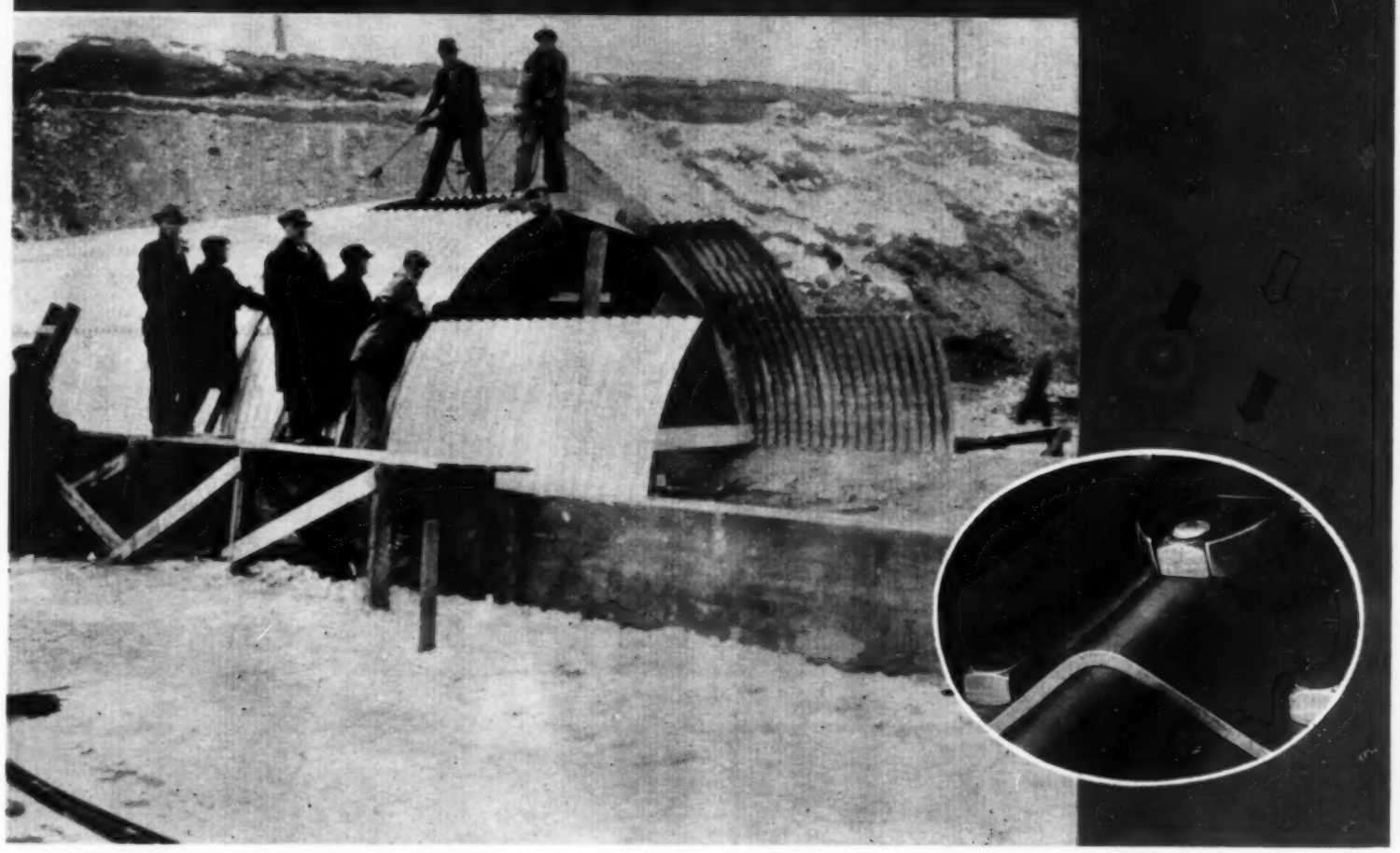
DOBBIE FOUNDRY & MACHINE CO.

Niagara Falls, N. Y.

Other Dobbie Products—Steel Derricks, Timber Derrick Fittings, Hand Winches, Motor Driven Winches, Blocks, Sheaves, etc.

as Simple to Erect

AS CHANGING A TIRE ON YOUR CAR



Cold Weather is No Hindrance

• When you put in an Armco Multi Plate structure remember this: It's strictly *a mechanical operation*—a matter of bolting together a number of corrugated iron plates to fit the design specified whether it be an arch or a pipe.

As a result, when a competent foreman is employed, even an inexperienced crew can erect an average-size Multi Plate installation in *a few days' time.* No special protection or expensive equipment is needed. Moreover, as soon as the last bolt is drawn tight, you can start placing the earth backfill directly against the metal plates. No "curing period" is necessary.

These are just a few of the reasons why leading engineers, contractors and public officials are turning to Armco Multi Plate for their large drainage structures. Here is a material that is "fool-proof" from start to finish—a material that saves time and money—a material that has the strength and durability to last a lifetime, without upkeep or repairs. Mail the coupon for prices and complete information. Armco Culvert Mfrs. Association, 703 Curtis St., Middletown, Ohio.

Armco

MULTI PLATE

For Small Bridges, Large Sewers, etc.

MULTI ARMCO PLATE

I WANT ☐ PRICES
☐ MORE INFORMATION
ON ARMCO MULTI PLATE CONSTRUCTION.

NAME _____

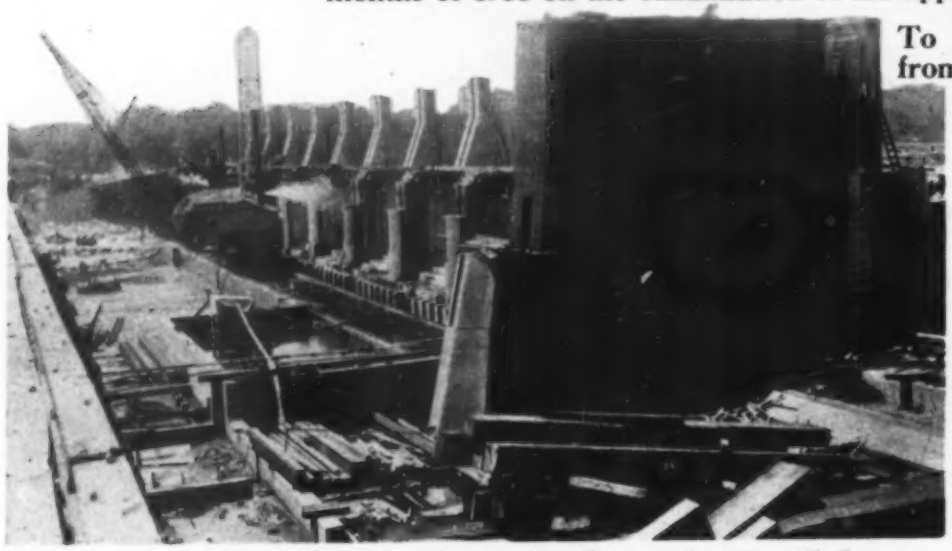
TITLE _____

ADDRESS _____

CM-11-36

An AWARD . . . *and a Contributing Factor*

To Siems Helmers, Inc., of St. Paul, builders of Dam No. 9. — goes the safety award for the first six months of 1936 on the canalization of the upper Mississippi.



To the GOODALL RUBBER CO. from Siems Helmers, Inc.

"The big Point of it all is that our hose is exclusively GOODALL HOSE which has been very satisfactory under the most severe tests."

Experience builds dams and bridges —

and rubber goods fit for the job.

In back of every GOODALL PRODUCT are over 50 years of specialized experience in the manufacture of contractors rubber goods.

GOODALL RUBBER CO.

New York · Philadelphia · Pittsburgh · Chicago · Cleveland · Houston

GOODALL MECHANICAL CORP.

San Francisco · Los Angeles · Seattle

Mills: Trenton, N. J.

Use Goodall Specialized Rubber Goods on your Jobs

GOODALL RUBBER GOODS

The originators of the "Standard of Quality" Line (Reg. U. S. Pat. Off.) of contractor's rubber goods.

After taking this photograph — which shows 14" and 16" piling being cut with a Wolf Portable Timber Sawing Machine by employees of the Galveston Wharf Company — we asked the Chief Engineer, Mr. R. E. Fristoe, three questions as follows:

(a) — *Has this machine given satisfactory Service?*
(b) — *Do you find it easy to handle?*
(c) — *Has it saved money since its installation?*

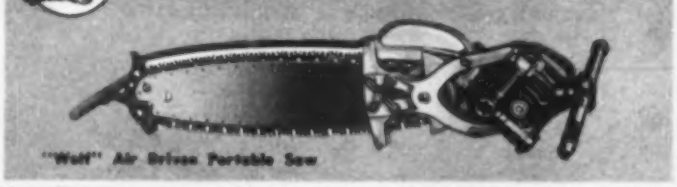
to all these questions Mr. Fristoe answered "Yes."

Hundreds of other engineers and construction executives have achieved big savings in time and money with this dependable, efficient, portable machine for cutting heavy timber, piling, etc. Operated by A.C. and D.C. Electric Motors, Air Motors, or air-cooled gasoline engine. Write for information which tells why leading contractors, everywhere, are enthusiastic about results.

REED-PRENTICE CORPORATION

WORCESTER MASS.

WOLF PORTABLE TIMBER SAWING MACHINE



"Wolf" Air Driven Portable Saw

SWIVEL HEAD CUTTER

The Swivel Head principle—of time-tested Porter design and construction—permits the head to swing in any degree, from in line with the handles, to a full right angle position on either side. It actually "bends to the job"—over, under and around obstructions. Full cutting power is maintained in every position. The most versatile cutter ever developed. Saves time and labor on all difficult jobs. Frees the operator from strain and awkward bending. Order from your supplier or write us for descriptive circular.

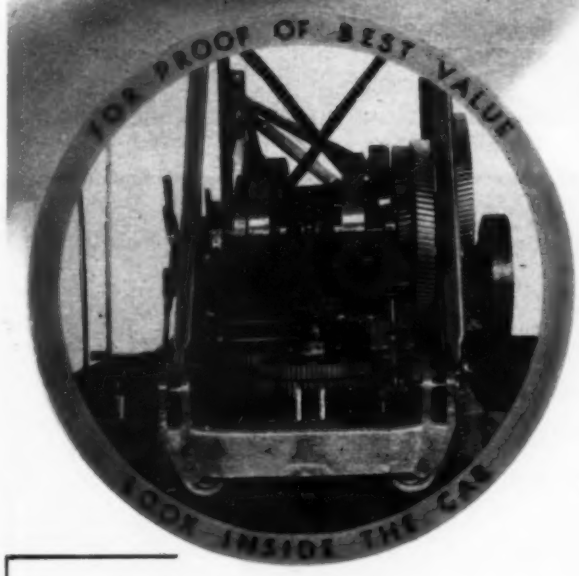
H. K. PORTER, INC.

EVERETT, MASS., U.S.A.

EST. 51 YEARS

and still the orders pile up!

for Bay City "20"

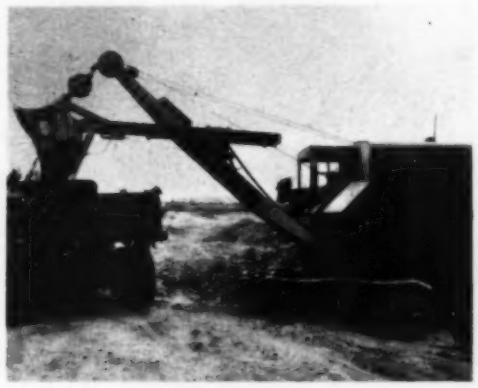


full revolving — full 3/8 yd. bucket — safe 4-ton crane loads . . . . . .

Yes—we're chock-a-block with orders for weeks ahead, and proud of it! It goes to prove that Bay City "20" is the biggest buy in small shovels today. For here's a "Big-little" shovel that has features of construction and operation found in no other 3/8-yarder. It tops its field in its weight and class. Look over these features—use your own judgment!

- Compact Design—Yet plenty of elbow room.
- Elimination of useless "dead weight"—by alloy steels and heat treating.
- Anti-friction bearings—on all machinery shafts and boom point sheaves.
- Chain Crowd—positive and independent—costs more but worth it.
- Drop Forged crawler shoes (14" wide) long wearing life.
- Unit Cast Car Body and Machinery Table of nickel-manganese steel, totally heat treated—available on no other light 3/8 yd.
- Six cylinder gasoline or Diesel Power—"E-Z" Clutch Control.
- Cut Helical Gears on all drum shafts—Helical gear drive, in oil.
- Safety Worm Boom Hoist—Positive Swing Lock—Cab in any position.
- Positive Propelling Lock—All controls from operator's seat.

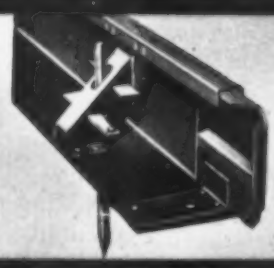
Note—There are TEN Models of Bay City Shovels, sizes from 3/8 to 1-1/4 yd. sizes—but no better buy than Bay City "20." Get in line for yours—for profits!



Recent Quantity Purchases: N. Y. State Pub. Wks. Dept.—8; New Zealand Pub. Wks. Dept.—7

BAY CITY SHOVELS Inc. (Eastern Offices, Roselle, N. J.) BAY CITY, MICH.

Equip with BLAW-KNOX



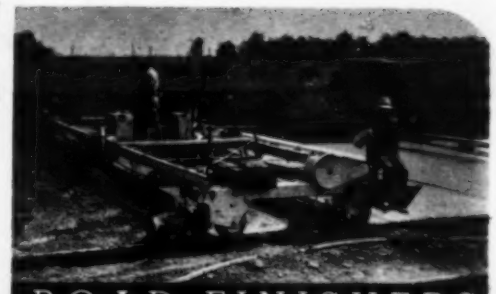
ROAD FORMS—
also Steel Asphalt Paving Forms

ROAD BUILDERS everywhere avail themselves of Blaw-Knox ability to design, build and fit equipment into the particular spot on the job where *reliability* means paving progress—and profits.

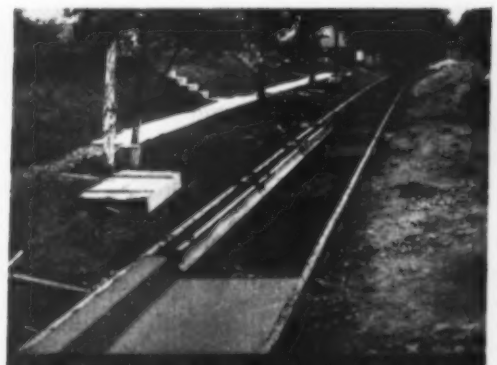
Your road building operations will proceed with uninterrupted speed with Blaw-Knox Equipment on the job.

Descriptive literature and prices will be furnished on request.

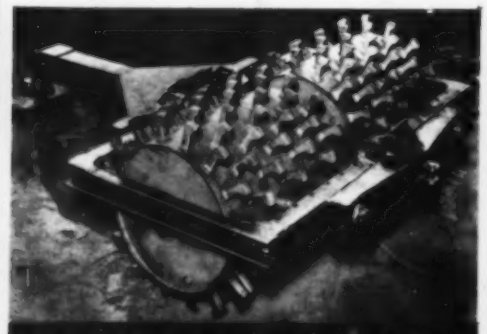
BLAW-KNOX COMPANY
2096 FARMER'S BANK BUILDING PITTSBURGH, PA.
Offices and Representatives in Principal Cities



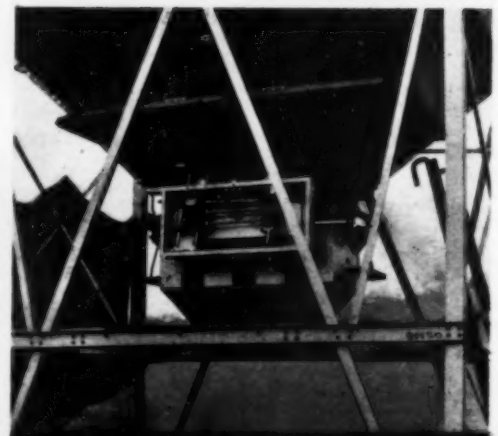
ROAD FINISHERS



STEEL STREET FORMS



TAMPING ROLLERS



WEIGHING BATCHERPLANTS

24" TRIMO *Supports More Than* 3 TONS

This test in which a 24" TRIMO Alloy supports over 3 tons of dead weight is proof positive of the tremendous strength of the new drop forged all Chrome Molybdenum TRIMO Pipe Wrench.

With construction increasing everywhere, you'll need more TRIMO Wrenches — and you'll find them the safest, most economical, strongest wrenches you can buy.

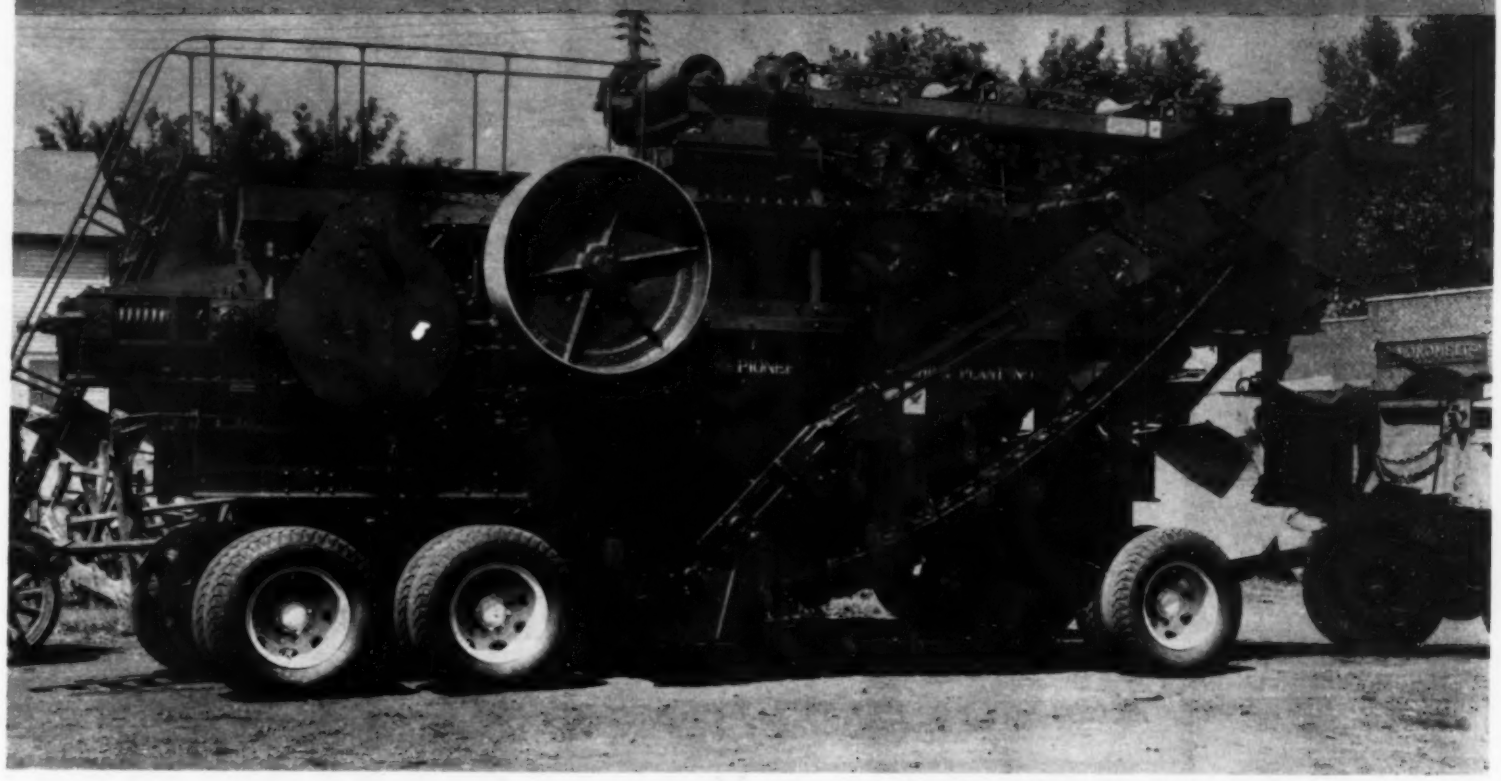
TRIMONT MFG. CO., INC.
ROXBURY (BOSTON), MASS.

Look for the Red Tag — always attached to every TRIMO Pipe Wrench

Large Capacity and Portability
are combined
in H&B Tower Type
PORTABLE ASPHALT PLANTS
—
Hot or Cold Mix
—
Bulletin T-247

HETHERINGTON & BERNER, Inc.
INDIANAPOLIS, INDIANA
Builders of Asphalt Paving Machinery for over thirty years

WANTED: TOUGHER JOBS FOR TIRES



This portable crushing machine can handle 1600 tons of rock per hour.

HARDEST HAULS PROVE VALUE OF GOODRICH TIRE INVENTION

Pick out the toughest hauling job you have. One where tires take a real beating. Then put Goodrich Triple Protected Silvertowns on that equipment. Prove to yourself that these tires will stand up where others blow out in the sidewall or wear bald in a hurry.

EXTRA MILES FREE

Goodrich engineers know construction industry problems. They brought out an invention especially designed to protect tires against the terrific sidewall strains that you get on dirt-moving projects. This invention is Triple Protection—a three-way development that checks 80% of premature truck tire failures!

This extra protection means extra miles—freedom from dollar-stealing sidewall breaks. That's why you'll find more and more truck users swinging to Silvertowns. Only Goodrich gives you this 3-way safeguard:

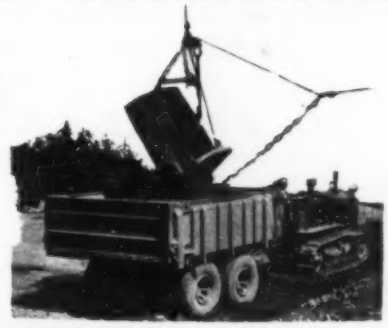
1 **PLYFLEX**—distributes stresses throughout the tire—prevents ply separation—checks local weakness.

2 **PLY-LOCK**—protects the tire from breaks caused by short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—eliminates cross cords from *all* plies—reduces heat in the tire 12%.

You pay no premium for Silvertowns. They cost no more than other standard brands. Before you buy another tire see a Goodrich dealer and make your own test on your toughest haul. The B. F. Goodrich Company, Akron, Ohio.

They pick Goodrich for the hard hauls—for instance, on this 25-yard buggy.



Silvertowns are a favorite for dump truck service.

80-ton loads will ride this Goodrich-equipped trailer.

Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

56-S RANSOME MIXERS
on the job--

- BUILDING MIXERS
- PNEUMATIC PLACERS
- TUNNEL FORMS
- BUCKETS—HOPPERS
- DUAL DRUM PAVERS
- PAVING MIXERS
- PNEUMATIC GROUTERS
- TOWERS—MASTS—CHUTES
- CARTS—BAR CUTTERS & BENDERS

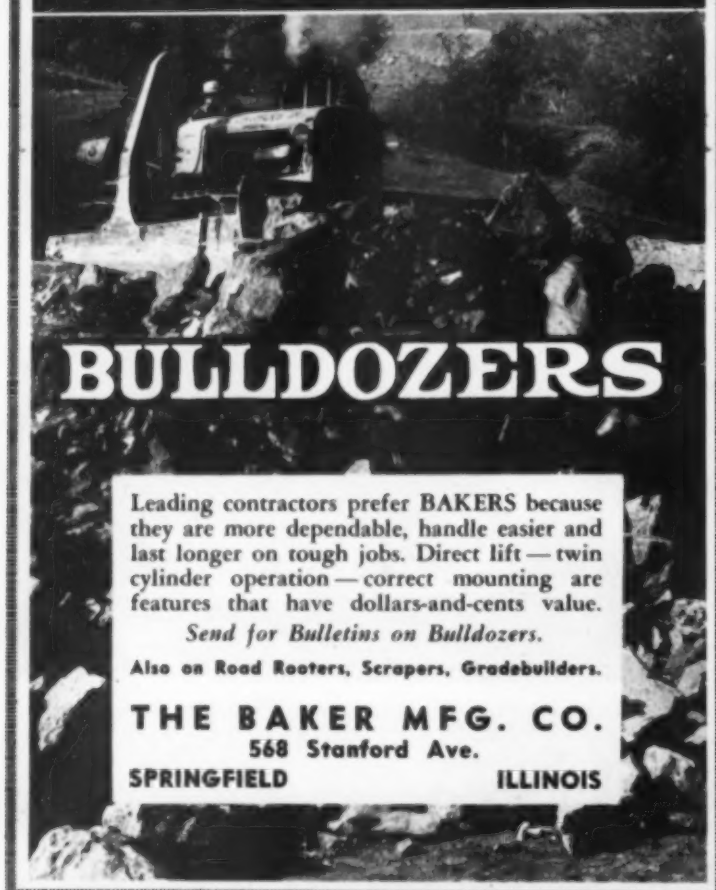
Two BIG Ransomes were used on this, the longest of the five new bridges constructed along the Oregon Coast highway. Costing $2,123,318 and with a total length of more than a mile, the piers and concrete approaches were *Ransome-built* by the Northwest Roads Company of Portland, Oregon. Thus we add *another* name to the long and lengthening list of Ransome-built jobs, both large and small — usually jobs on which *multiple Ransomes* were employed to cut costs and save time. Whatever your size job, there's a Ransome Mixer built to build it at most profit to you. Investigate — now.

RANSOME CONCRETE MACHINERY CO.
DUNELLEN . . . NEW JERSEY
Cable Address: "Racomaco" Dunellen

Ransome big mixers for big jobs

RANSOME MIXERS FOR *all* JOBS

BAKER



BULLDOZERS

Leading contractors prefer BAKERS because they are more dependable, handle easier and last longer on tough jobs. Direct lift — twin cylinder operation — correct mounting are features that have dollars-and-cents value.

Send for Bulletins on Bulldozers.

Also on Road Rooters, Scrapers, Gradebuilders.

THE BAKER MFG. CO.
568 Stanford Ave.
SPRINGFIELD ILLINOIS

Sika

WATERPROOFING

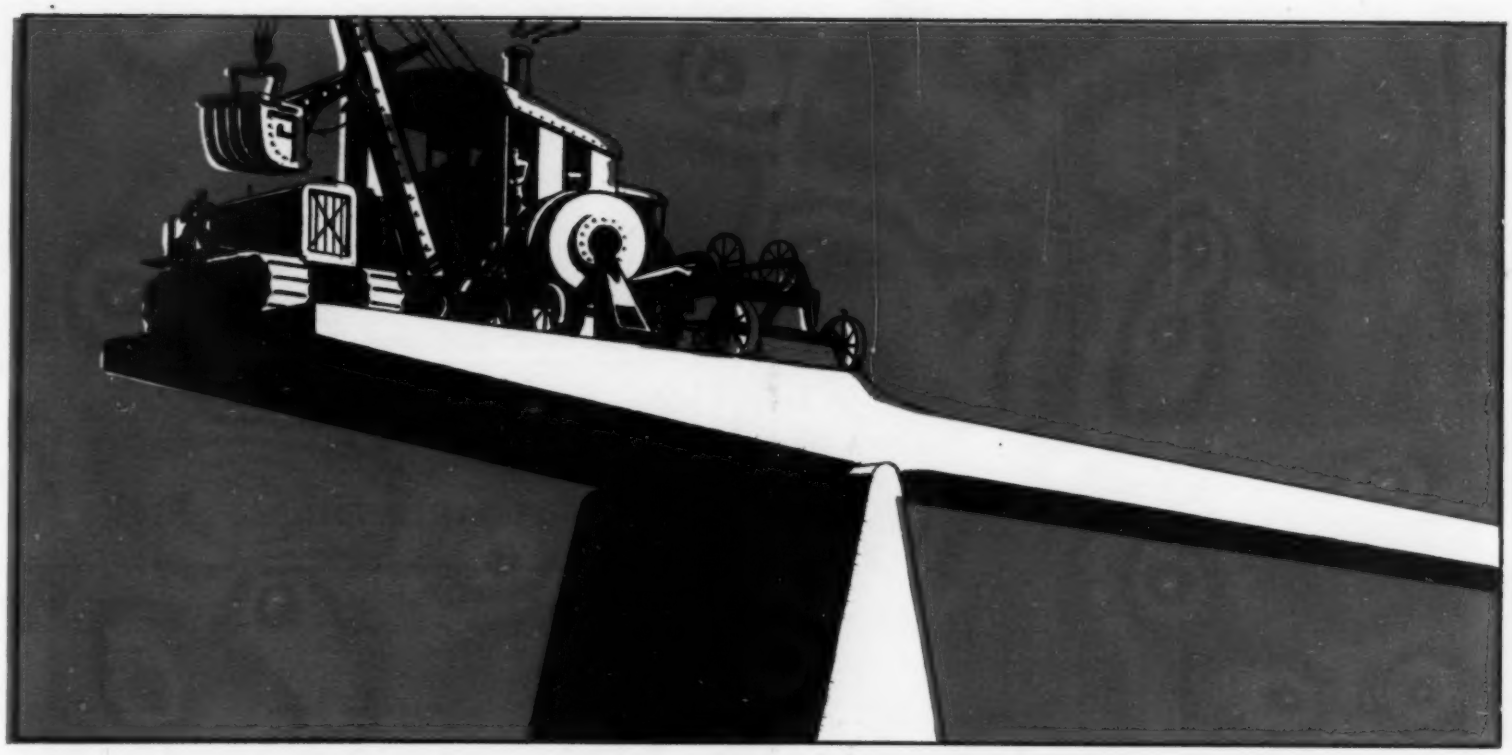
■ When you have leakage through structurally sound masonry, or—
When specifications call for "water-tight" concrete in dams, tunnels, filter beds, manholes, sewage tanks, walls, floors, etc.—

Remember that SIKA will successfully seal off infiltration from inside even under pressure. One contractor writes:— "we used SIKA to stop water leaking through the concrete lining in a water tunnel. . . . the head of water was approximately fifty feet and the SIKA was successful in stopping the leaks."

There is a SIKA compound for practically every condition — mixed with portland cement it is easily applied by hand.

Write us about your waterproofing probelms.

SIKA Inc. 1943 Grand Central Terminal NEW YORK, N. Y.



MODERNIZATION CREDIT

A LEVER *to raise your equipment's efficiency*

CHECK THIS LIST!

Types of machinery and equipment listed below, if purchased on credit, may easily pay for themselves out of earnings or savings.

Concrete handling equipment including
- compressors
- shovels — Diesel, gas, steam
- crushing and grinding equipment
- bull dozers
- graders, scrapers
- pavers
- ditchers
- tractors
- material handling equipment
- etc.

Would a battery of new type machines speed up your handling of a job? Or a new power unit for your plant effect year around savings?

No matter what type, or how large the amount of new machinery and equipment you need, it may now be purchased on the E. A. C. Modernization Credit Plan.

Your payments are spread over a period up to 36 months, giving the equipment an opportunity to help pay its own way.

The charge for E. A. C. Credit is the lowest generally available for similar financing and is usually less than the present cost of floating small capital issues. It is also free from red-tape, burdensome detail and supervision of your business, often associated with other current forms of financing.

So ask your supplier about this E. A. C. Modernization Credit Plan. Or, if you prefer, we are glad to have you write us.

Send this → memo today

EQUIPMENT ACCEPTANCE CORPORATION

A UNIT of COMMERCIAL INVESTMENT TRUST CORPORATION

1 Park Avenue, New York City

CAPITAL AND SURPLUS OVER $100,000,000

Without obligating myself in any way, I am interested in considering taking advantage of your Modernization Credit Plan to purchase such equipment as:

DESCRIPTION AND MAKE OF EQUIPMENT	ESTIMATED COST

FIRM NAME

ADDRESS

REPLY TO

G&R PUMPS WILL NOT CLOG!

The fast, sure pumping of their first G & R, purchased in October of 1934, had so completely satisfied E. A. Kramme Co. Inc., of Des Moines, that when another pump was needed for their bridge job near Des Moines this year, they bought another G & R.

Performance of those two pumps—a 4" and a 6" G & R—on this steady grind of twenty-four hour a day service was just another demonstration of the dependability they had already learned to expect from the ruggedly simple design of this gadgetless self priming centrifugal. Never a shut down for cleaning out the pump. Full volume pumping as long as there was water to be moved. Fast, sure prime the moment water covered the end of the intake. No attention necessary except to keep the motor supplied with gas and oil.

Put a G & R on your next job. Our distributors in 100 principal cities are ready to make prompt delivery.

REPEAT ORDERS

keep coming—because we build the

MOST DEPENDABLE PUMPS

for the least money

THE GORMAN-RUPP CO.
Mansfield, Ohio

Answers to your problems in structural engineering always at your finger tips

EVERY man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods and details.

Hool and Kinne's

Structural Engineers' Handbook Library

6 Volumes—3575 pages—fully illustrated

The most valuable library obtainable for any man concerned with the design and construction of civil engineering structures of any type.

Under the general editorship of George A. Hool, formerly Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Editors-in-Chief of the Library, *Sixty-Six* of the leading, practical operating structural engineers of the United States and Canada give you the very cream of their knowledge of structural engineering.

They give you six well bound, fully illustrated volumes, containing 3,575 pages of practical, authoritative information covering every phase of structural engineering from foundation and substructure work to the completed erection.

Every man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods information and details. The six books are:—1. Foundations, Abutments and Footings. 2. Structural Members and Connections. 3. Stresses in Framed Structures. 4. Steel and Timber Structures. 5. Movable and Long-Span Steel Bridges, and, 6. Reinforced Concrete and Masonry Structures. With these books on hand you cannot make mistakes.

By placing this Library on your bookshelf you are putting within arm's reach years of actual first rate experience with structural problems. Do not forget either, that these men are all EXPERTS in their lines.

10 DAYS' FREE EXAMINATION

Send us the coupon below, properly filled in, and we will send the Library to you for 10 days' FREE examination. If you examine the books carefully you will want to keep the Library. In that case just send us $3.50 and then $3.00 per month until the total price of $27.50 has been paid.

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Company, Inc., 330 West 42d Street, New York.

You may send me **Hool and Kinne's Structural Engineers' Library** for my inspection. If the books prove satisfactory, I will send $3.50 in 10 days and $3.00 per month until I have paid the price of the books, $27.50. If the books are not what I want, I agree to return them postpaid within 10 days of receipt.

Signature .....

Home Address .....

City and State .....

Name of Company .....

Occupation .....

(To insure prompt shipment write plainly and fill in all lines.)

CM-11-36

Chicago's New American Home on the east side of Michigan Ave. just north of Roosevelt Road is attracting tens of thousands of visitors— and making converts to concrete. Construction step-by-step views shown at right.

Realtors and subdividers are creating a new and profitable field for the general contractor

1936 is a record year in the volume of concrete homes! Contractors who know concrete construction have a double opportunity to cash in on this active market. First, through their own promotional efforts and the building of model homes. Second, by tying up with one of the many realtors or subdividers who are either organizing construction departments or attempting to make satisfactory connections with builders. It's a great chance to make mutually profitable cooperative arrangements.

Concrete gives the contractor a chance to build easily salable homes that combine beauty, firesafety, permanence and economy. They take any architectural style; they may be built with masonry or reinforced concrete walls. But no matter how you build you can profitably capitalize on your skill and experience in organizing the construction of foundations, walls, floors, stairways and roofs of concrete. Porches, sidewalks, terraces, driveways and garages are extra opportunities for profit.

You have the men, the equipment and the knowledge to build concrete homes economically — one at a time or by the hundreds. Check the coupon and attach to your letterhead for further information and practical booklet.

PORTLAND CEMENT ASSOCIATION Dept. A11-16, 33 W. Grand Ave., Chicago, Ill.

☐ I am interested in home construction as a contracting opportunity.

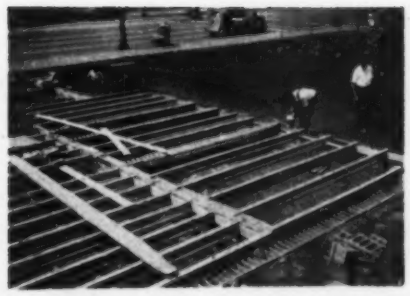
☐ Send "Reinforced Concrete Houses — Construction Details."

NAME .....

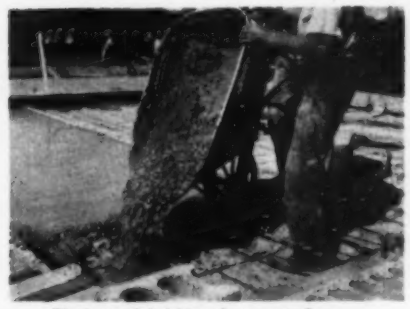
Company .....

Address .....

City ..... State .....



Precast concrete joists set in place ready for first floor.



Placing and finishing the concrete floor.

Laying up walls with cinder block concrete masonry units.

The big concrete blocks are easy to handle, quick to lay.

Detail view showing construction of fireproof partitions.

General view of the job nearing completion.

Special Owen Buckets too!

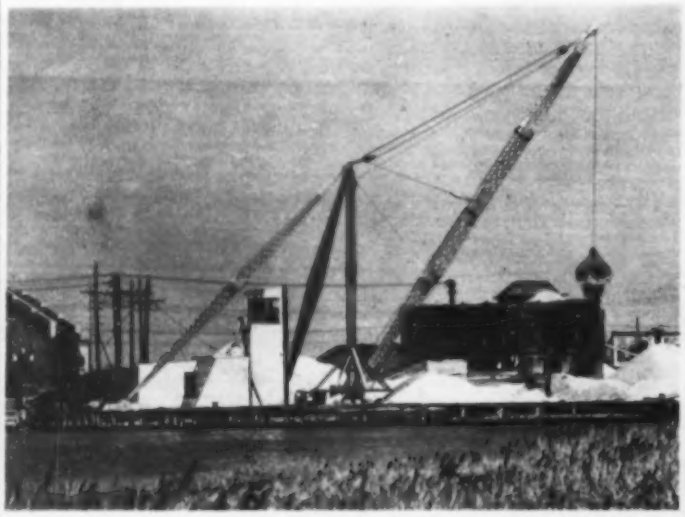
Owens' record in designing and building successful buckets for uncommon service is the natural result of long specialized experience and the availability of exclusive patented features of fundamental importance.

Consult us regarding your needs for regular or special buckets and grapples.

THE OWEN BUCKET COMPANY
6020 Breakwater Avenue • Cleveland, Ohio
Branches: NEW YORK • PHILADELPHIA • CHICAGO • BERKELEY, CAL.

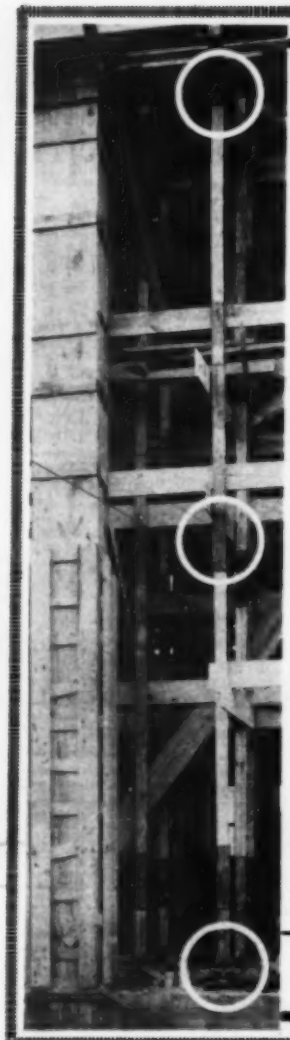
OUTSTANDING!

. . . In performance, quality and value — that is the reputation of Clyde equipment. A reputation based on the opinions of thousands of satisfied Clyde owners and operators all over the world. Clyde equipment is modern equipment. . . designed to meet modern demands for stamina, speed and economy.



Clyde 15 ton steel derrick operated by Clyde electric hoist and swinger; handling stone for Flushing Sand and Stone Co., Flushing, N. Y.

CLYDE SALES CO.
Duluth, Minn.



FASTER

FORM ERECTION AND STRIPPING WITH

COSCO EQUIPMENT

• Shoring costs are cut three ways with these three simple COSCO units and 4"x4" timbers. You save three-fourths of the labor ordinarily required for making up, leveling and cambering forms. You save on stripping, transporting, or storing and again on the original cost of shoring material.

At the same time you get a stronger, more flexible construction. Bracing and tying of long shores is wood to wood — with no special fastenings required. Settling of forms is easily corrected with the 9 inch jack adjustment.

Get all the facts on this tried and proven method of reducing your costs of shoring, bracing, scaffold splicing, etc.

JACK

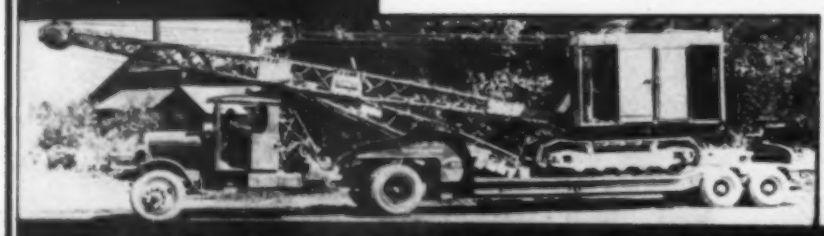
TEE

SPLICE

CONSTRUCTION SPECIALTIES CO.
OLIVER BUILDING — COSCO — PITTSBURGH PENNA.

ROGERS ON PNEUMATICS

Eight wheel rear on 4 rocking axles. Drop deck—20 ton trailer



• ROGERS TRAILER ACHIEVEMENTS •

THE REWARD OF VISION

The development of the Heavy Duty Trailer Industry has been the history of Rogers Brothers Corporation. The heritage of a remarkable record in solid tire trailer progress and performance is your assurance of continued dependability in the newer *Rogers Gooseneck Heavy Duty Trailer* — on pneumatics.

Frame welded throughout — all castings of Electric Steel — all wheels mounted on Timken Heavy Duty Bearings — level deck and drop deck types available.

"EXPERIENCE BUILT IT — PERFORMANCE SOLD IT"

ROGERS BROTHERS CORPORATION . . . ALBION, PA.

Photo shows a "620" Page Walker (125' boom 3½-cu.yd. bucket) stripping gypsum at National City, Michigan.

High Yardage WALKING DRAGLINE

for COAL STRIPPING • LEVEE BUILDING
GENERAL EXCAVATION • RECLAMATION WORK
PLACER MINING

The PAGE Walker Series "600" Diesel Powered—Moderately Priced (3 to 5-cu.yd. machines immediately available).

A completely modern, rugged, dragline machine with high load, hoist, and swing speeds for greater yardage 24 hours per day, month after month.

PLUS—A large circular base and a simple positive crank-action walking mechanism which permits working on the softest ground—guarantees immediate movability in any direction.

If your work requires more yardage—lower operating cost—longer reach—complete independence of weather conditions—learn all about the Page Walker Series "600."

Page Engineering Co.

Clearing Post Office • • Chicago, Ill.

PAGE AUTOMATIC DRAGLINE BUCKETS
PAGE WALKING DRAGLINE MACHINES
PAGE DIESEL ENGINES

PAGE ENGINEERING COMPANY
CLEARING POST OFFICE CHICAGO, ILLINOIS

Please send information on a Page "600" Walker. Size _____

Name _____

Address _____

City _____ *State* _____ "S"

Speed up Construction . . .

Cut Costs . . with J&L Steel Products

You speed up construction on every job—and cut your costs, too —when you use Jones & Laughlin steel products.

You speed up construction because the uniform high quality and strict conformity to specifications of all J & L construction products mean that they can be quickly and easily fabricated, assembled and erected.

You save time and money, too, because the wide variety of J&L steel products enables you to concentrate your purchases with a single reliable organization.

J&L construction products are widely used because engineers and contractors have learned from experience that they can always depend on them for uniform high quality and completely satisfactory performance.

Specify J&L steel products on your next job. Their use will shorten construction time, help you maintain your construction schedules, and cut your costs.

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS

JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

Sales Offices: Atlanta Boston Buffalo Chicago Cincinnati Cleveland Dallas Denver Detroit Erie Houston Los Angeles Memphis Milwaukee Minneapolis New Orleans New York Philadelphia Pittsburgh Seattle St. Louis San Francisco Tulsa

Warehouses: CHICAGO CINCINNATI DETROIT MEMPHIS NEW ORLEANS NEW YORK (Long Island City)* PITTSBURGH

*Operated by National Bridge Works Division of Jones & Laughlin Steel Service, Inc.

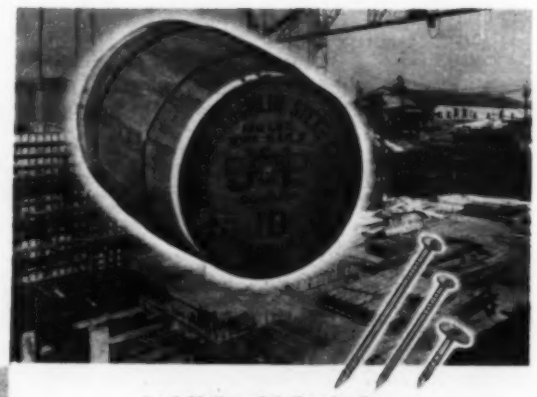
Canadian Representatives: JONES & LAUGHLIN STEEL PRODUCTS COMPANY, Pittsburgh, Pa., U. S. A., and Toronto, Ont., Canada

Shorter Driving Time with J & L Steel Piling

The straightness and proper interlock clearance of J & L Steel Piling permit easy and accurate assembly and free plumb driving which in turn mean shorter driving time. J & L Steel Piling assures trouble-free performance in all types of steel piling work.

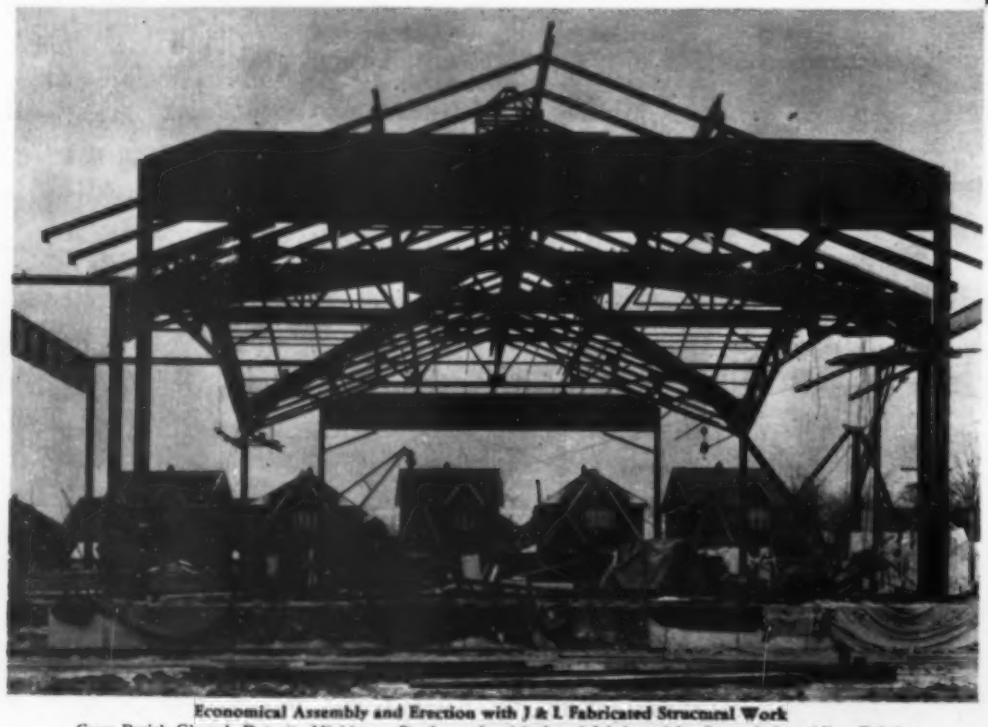
Low Cost Construction with J & L Junior Beams

Construction view, High School Stadium, Aliquippa, Pa. J & L Junior Beams were used in this construction because they provide adequate strength with light weight and offer ease of fabrication and erection. J & L Junior Beams can be erected quickly, easily and economically.



J & L Nails and Spikes for Every Construction Requirement

J & L Nails and Spikes are made of carefully selected wire in a wide range of types and sizes. They are accurate as to length and gage, with clean surfaces, uniform heads, and well-cut points.



Economical Assembly and Erection with J & L Fabricated Structural Work

Gesu Parish Chapel, Detroit, Michigan. Steel was furnished and fabricated by Jones & Laughlin. Fabricating plants are operated by Jones & Laughlin at Pittsburgh, New Orleans and Long Island City, N. Y.

LOOK TO J&L FOR ALL YOUR STEEL REQUIREMENTS

Steel Piling . . . Plates . . . Structural Shapes including Junior Beams and Lightweight Channels . . . Bars for Concrete Reinforcement . . . Assembled Road Bar Mats . . . Tie Wire . . . Steel Pipe . . . Fabricated Structural Work including Steel Plate Construction . . . Nails and Spikes.

J&L STEEL

LATEST SCIENTIFIC FINDINGS SHOW THE VALUE OF CALCIUM CHLORIDE IN PORTLAND CEMENT CONCRETE

HIGHEST technical authorities, including the U. S. Bureau of Standards, Portland Cement Association, and state highway departments, know after years of testing that Calcium Chloride is a beneficial agent in Portland Cement concrete. It is an automatic curing agent, makes a more workable mix, gives higher early strength, permitting quicker removal of forms—in short, provides so many benefits that officials and contractors cannot afford to do without it.

CURES PAVEMENTS

Calcium Chloride takes the place of earth, straw and other costly, cumbersome curing methods. Pavements cured with Calcium Chloride in the mix develop required opening strength in half the time of old-fashioned curing methods. Forms may be removed sooner, and the same forms used on twice as much work. Hauling of earth or other covering materials, as well as constant inspection and wetting, are entirely eliminated. Curing is fast, safe and automatic with Calcium Chloride.

FASTER FLOOR FINISHING-EASIER TO WORK

Rapid development of hardening and high early strength permit rapid finishing of floors to keep up with structural work. Being made more plastic with Calcium Chloride, concrete trowels more easily and flows more readily into forms, which may be removed in a shorter time for use on other work.

NEEDED IN ALL CONCRETING-PAVEMENTS, FLOORS, STRUCTURES OR PRODUCTS

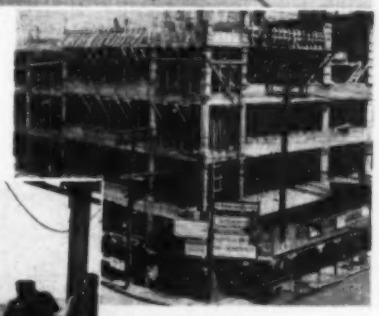
Tests prove Calcium Chloride's reliability, safety and practicability. Improved workability, wearing quality, density, low volume change, accelerated hardening, and cold weather protection are now all confirmed by scientific facts. Its moisture control is especially needed in block, tile and thin-section structural work where exposure causes rapid drying out.

Write for special information on your particular problem.

Calcium Chloride Association

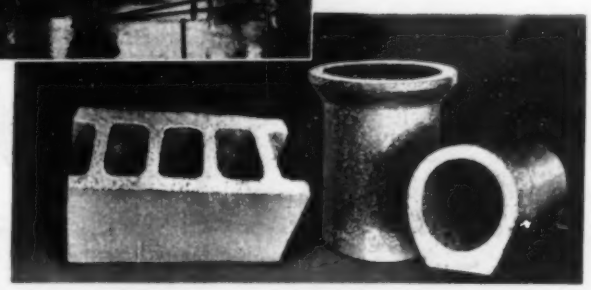
The Dow Chemical Company . . . . . Midland, Michigan
Michigan Alkali Company . . 60 E. 42nd St., New York City
Solvay Sales Corporation . . . 40 Rector St., New York City
The Columbia Alkali Corporation . . . . Barberton, Ohio

Calcium Chloride Curing is faster—more automatic.



Calcium Chloride Curing is the only practical method for curing vertical structural concrete.

Above—Faster finishing is made possible by including Calcium Chloride.



Right—Concrete products need Calcium Chloride Curing.

CALCIUM CHLORIDE
FOR MODERN CONCRETE CURING

25 MILES PER HR. ROAD SPEED *with* ORDINARY TRUCK ECONOMY

—that's MOBILITY!

In every sense of the word, MICHIGAN is a *MOBILE* power shovel! From the standpoint of speed, economy, convertibility and dependability it has no equal in its size for highway maintenance and for hard use in yard, pit, quarry or construction jobs. Here is *real* truck shovel, crane, dragline and trench-hoe equipment *from the ground up!*

Write for new illustrated Bulletin

MICHIGAN POWER SHOVEL COMPANY
Benton Harbor, Michigan U.S.A.

INSLEY ROUND TYPE BUCKET

Center Dump — Easily Controllable

Narrow doors for dumping in forms. The operator stands on the forms at the end of the door —

Wide, square doors for mass concrete.

The achievement of 30 years experience since Insley offered to the industry its first controllable, center dump bucket.

INSLEY ROCKER DUMP HAND CART

Roll on rubber. An easy, clean dump.
6 Cu. Ft. — 9 Cu. Ft. — 12 Cu. Ft.

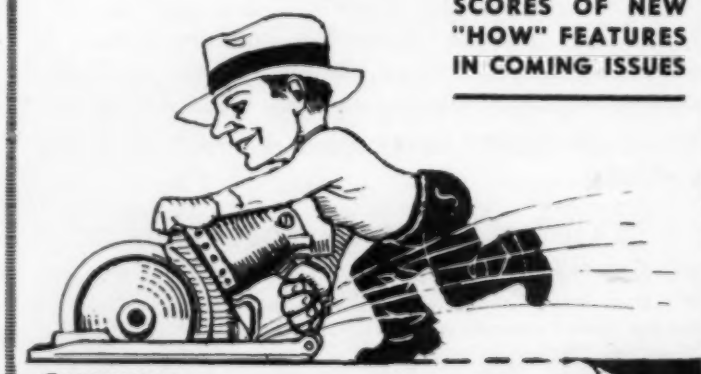
Send For Bulletins

INSLEY MANUFACTURING CORP.
Olney and E. St. Clair St.
INDIANAPOLIS, IND.

Cut it OUT!

Quit borrowing CONSTRUCTION METHODS from your long-suffering friends — and cut out this coupon so that you will have your own copy each month to enjoy at leisure and keep for future reference.

DON'T MISS THE SCORES OF NEW "HOW" FEATURES IN COMING ISSUES



CONSTRUCTION METHODS
330 West 42nd St., New York, N. Y.

I want the $1 saving on the special Two-Year Subscription Rate of $3. (Check here ☐ if you prefer one year — 12 issues — for $2.)

Name .....

Address .....

City ..... *State* .....

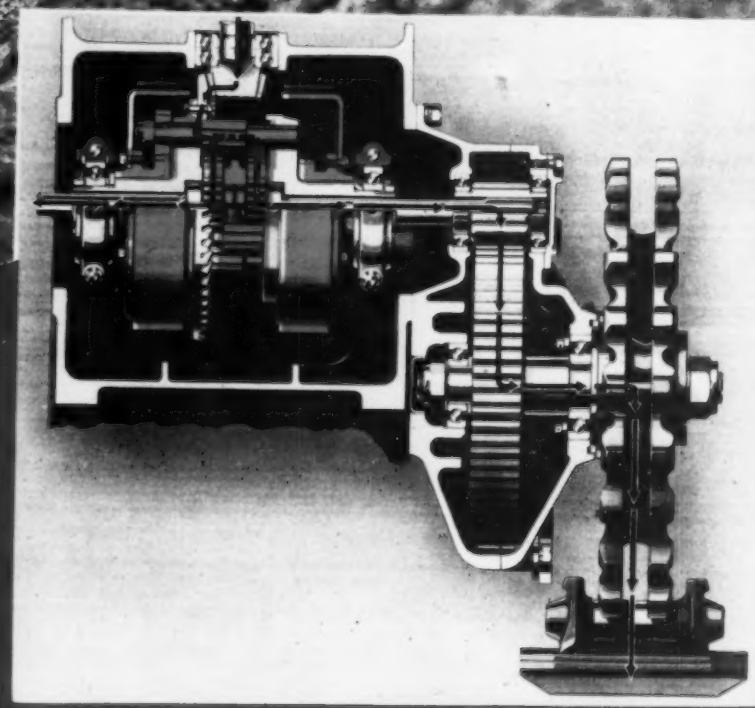
Company ..... *Position* .....

DON'T MISS THE NEXT ISSUE — MAIL COUPON TODAY

CONTROLLED DIFFERENTIAL STEERING

Cletrac
Crawler Tractors
Built To Endure
REG. U.S. PAT. OFF.

An Exclusive CLETRAC Feature



The arrows show the path of the power through the differential. Parts in color represent the mechanism used in Cletrac steering. In Cletrac design you will find many proved advantages that assure safer, lower-cost operation. For twenty years the advantages offered only by Cletrac have won increasing praise from Cletrac users.

This Cletrac feature is one of many that assure easy and safe control, low cost operation and ability to perform amazingly well.

The Controlled Differential Steering is a differential gearing by means of which *both* tracks of your Cletrac are *always* driving the tractor. One track can be speeded up, the other slowed down, for short turns. Your Cletrac is always pulling with both tracks.

Going downhill, uphill or around curves, *under full load*, the operator has the same sure control as on a straight level pull. Sharp turns are made with ease. That means low cost operation, greater dependability.

Cletrac Controlled Differential Steering and other Cletrac features will be explained to you gladly. A request will bring you complete information.

THE CLEVELAND TRACTOR CO.

CLEVELAND, OHIO

SERVICE Construction Methods SECTION

QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with Quinn Pipe Forms. Produce uniform concrete pipe of highest quality.

HEAVY DUTY CONCRETE PIPE FORMS

Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length.

NEW MEDIUM DUTY CONCRETE PIPE FORMS

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

WRITE TODAY

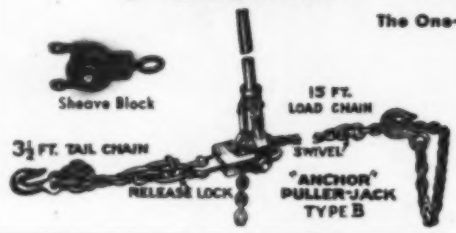
For prices and features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs. Also manufacturers of concrete pipe machines for making pipe by machine process.

QUINN WIRE & IRON WORKS

1439 TWELFTH ST. BOONE, IOWA

"Anchor" Puller-jack

The One-Man Outfit for Pulling, Moving, Shifting Heavy Loads

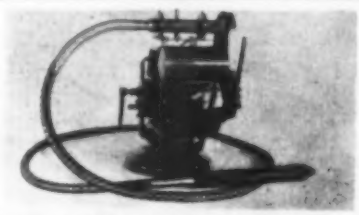


- Comes in handy on dozens of odd jobs on construction and engineering work. Easily handled by one man. Works in any position. Pulls 5000 lbs. single line; 10,000 lbs. on two line. Thousands in world wide use.
- Pulls anything — concrete forms, piling, lagging, stalled trucks. Handles heavy machinery. Shifts R. R. tracks or cars. Joins pipes, belts or conveyors. For erection, rigging and demolition work.
- Type B Puller-jack, complete as shown $30.00 f. o. b. factory. Weight 80 lbs. Longer chains at small extra price.

EDELBLUTE MANUFACTURING COMPANY
Reynoldsville, Penna.

COMPLETE
WELL POINT SYSTEMS
WILL DRY UP ANY EXCAVATION
Faster—More Economically
Write For Job Estimate and 32 page Catalog
COMPLETE
MACHINERY & EQUIPMENT CO., Inc.
36-36 11th St., Long Island City, N. Y.
Tel. IRonsides 6-8600

Shuredry & Fulter
TARPAULINS
FOR EVERY CONSTRUCTION NEED
Tents, Windbreaks, Burlap for road work — in bale-Waterproofed duck, Cotton Duck in rolls, Drop Cloths. Write today for Catalog, samples and price list.
Fulton Bag & Cotton Mills
Atlanta St. Louis Dallas
Minneapolis Brooklyn New Orleans Kansas City



Concrete VIBRATORS and Grinders
Write for Circular on types, sizes and prices
White Mfg. Co.
ELKHART INDIANA

GRIFFIN WELLPOINT SYSTEMS
Keep Your Wet Jobs Ahead Of Schedule.
The Choice of Contractors who investigate efficiency and cost
Job layouts and estimates furnished
Send for Catalogue B
GRIFFIN WELLPOINT CORP.
60 East 42nd Street, New York, N. Y.
Phone Murray Hill 2-2238

Giant-Gript Hand Paving Tools
STRAIGHT EDGES — Aluminum or Steel • **EDGERS** — Stamped or Cast Iron • **HAND FLOATS** — Standard or Special • **BULL FLOATS** and **HAND SCREEDS** • **CONCRETE BROOMS** of Bass or Bassine.
L. and M. MANUFACTURING COMPANY
Division of Mondio Forge Company, Inc.
10300 BEREA ROAD, CLEVELAND, OHIO

JACKSON CONCRETE VIBRATORS
FOR EVERY PLACING PROBLEM
Write for Information
ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON — MICHIGAN

● HYDRAUGER ●
MODERN HORIZONTAL BORING MACHINE
For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time.
Send for Bulletin.
HYDRAUGER CORPORATION, LTD.
116 New Montgomery St. • San Francisco, California

"ACME" ROAD MACHINERY
Heavy Duty—Larger Capacity—Longer Life—
Try a new Acme Reduction Crusher or a new Acme H. D. Roller Screen on your new job.
Guaranteed rebuilt or used equipment available on attractive lease or sales contract.
For Satisfaction and Service use Genuine **"ACME"** Parts. Communicate with nearest Dealer, main office—*Frankfort, N. Y. or 120 Liberty St., New York City.*

To MANUFACTURERS
This space costs 37½ cents per thousand readers. A trifling sum compared to the service it can render in contacting possible buyers of your products.

SEARCHLIGHT SECTION

SALESMEN WANTED

SALESMAN

Experienced in selling to industries and other large properties. We feature a flooring material that cannot be worn out. Carloads being sold to America's largest concerns for surfacing old floors of all kinds. Highest commissions; bonus for beginners. Protected territories.

UNITED LABORATORIES, INC.
Boston, Philadelphia, Cleveland, Detroit, Chicago, St. Louis, Seattle, Cincinnati, Jacksonville

FOR SALE

FOR SALE
GANTRY CRANE OR ORE BRIDGE

130′ c.c Rails—60′ overhang one end & ton bucket or 10 ton hook suitable for dock, material yard, coal or bulk material.

Electrical equip	$2,500.00
Bridge & runway	30.00NT
(as is—where is)	
1—25 ton Alliance crane, 49′ span, 230 V. D. C.	2,500.00
1—15 ton P. & H. Crane, 39′ span, 230 V. D. C.	1,500.00
Bldg. for this crane F.O.B.	30.00NT
28′′ Beth. I's, 40′ lengths; 30′′ Beth. I's, 30′ lengths	225.00NT F.O.B. Cars

HETZ CONSTRUCTION CO., INC.
P. O. Box 7 Niles, Ohio PH 1303

LEGAL NOTICE

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of Construction Methods, published Monthly at New York. N. Y., for October 1, 1936.

State of New York
County of New York ss

Before me, a Notary Public in and for the State and county aforesaid, personally appeared D.C. McGraw, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Construction Methods, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, N. Y. C. Editor, Robert K. Tomlin, 330 West 42nd Street, N. Y. C. Managing Editor, None. Business Manager, William Buxman, 330 West 42nd Street, N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its names and address, as well as those of each individual member, must be given.) McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. Stockholders of which are: James H. McGraw, 330 West 42nd St., N. Y. C. James H. McGraw, Jr., 330 West 42nd St., N. Y. C. James H. McGraw, James H. McGraw, Jr., & Malcolm Muir, 330 West 42nd St., N. Y. C. Trustees for: Harold W. McGraw, James H. McGraw, Jr., Donald C. McGraw, Curtis W. McGraw. Curtis W. McGraw, 330 West 42nd St., N. Y. C. Donald C. McGraw, 330 West 42nd St., N. Y. C. Anne Hugus Britton, 330 West 42nd St., N. Y. C. Mason Britton, 330 West 42nd St., N. Y. C. Grace W. Mehren, 33 West Grand Ave., Chicago, Ill. J. Malcolm Muir & Guaranty Trust Co., of New York, Trustees for Lida Kelly Muir. 524 Fifth Ave., N. Y. C. F. S. Weatherby, 271 Clinton Road, Brookline, Mass. Midwood Corporation, Madison, N. J. Stockholders of which are: Edwin S. Wilsey, Madison, N. J. Elsa M. Wilsey, Madison, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

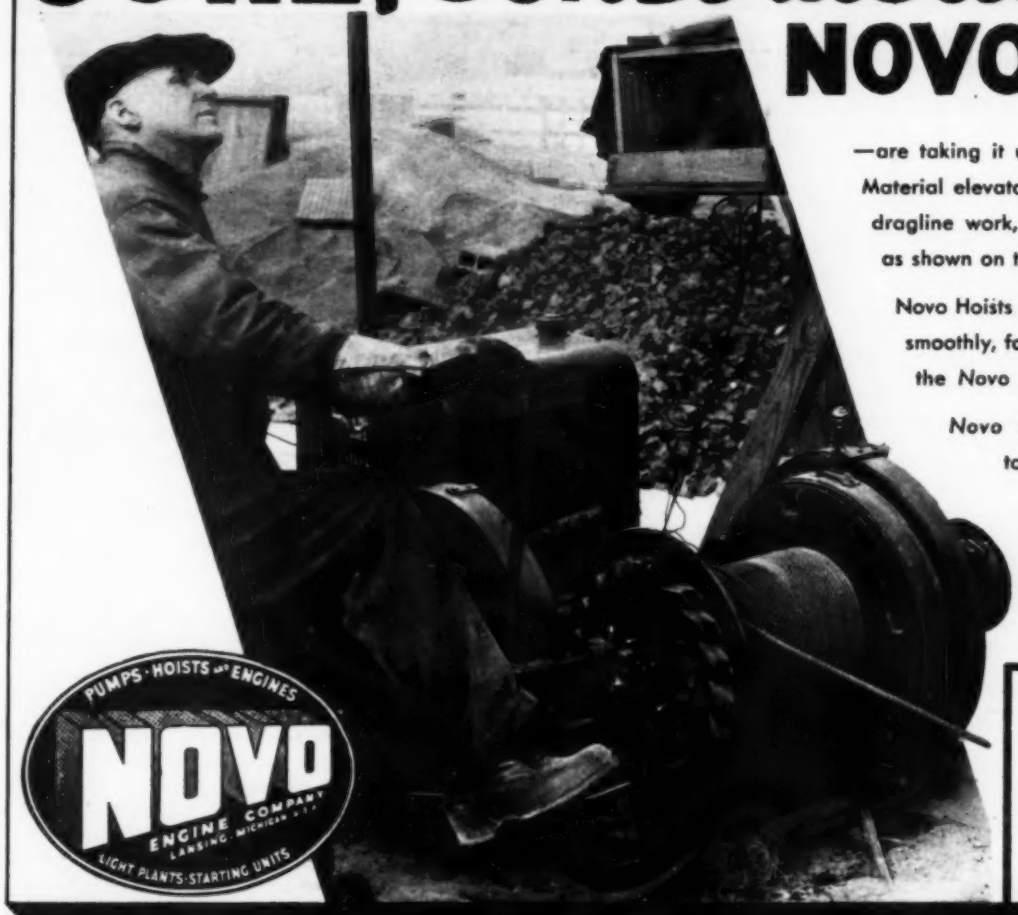
5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is. (This information is required from daily publications only.)

D. C. McGRAW, Secretary
McGRAW-HILL PUBLISHING COMPANY, INC.

Sworn to and subscribed before me this 28th day of September, 1936.

(SEAL) H. E. BEIRNE,
Notary Public, Nassau County. Clk's No. 74, N. Y. Clk's No. 192. Reg. No. 8-B-115.
(My Commission expires March 30, 1938.)

SURE, Construction's UP! NOVO HOISTS—



—are taking it up every day on a wide range of jobs. Material elevators, concrete masts, pile driving, erection, dragline work, etc. Sizes range from the little devils, as shown on the left, up to 100 HP, 14,000# line pull.

Novo Hoists pick up their load easily and shoot it up smoothly, for they have a greater friction area with the *Novo V Shaped, Double Area Friction Blocks.*

Novo Patented Screw Thrust gives feather touch control, minute accuracy of operation and an ease of manipulation that cuts operation overhead and operator fatigue.

Send for descriptive literature.

PUMPS · HOISTS AND ENGINES
NOVO
ENGINE COMPANY
LANSING · MICHIGAN U.S.A.
LIGHT PLANTS · STARTING UNITS

NOVO ENGINE COMPANY
214 Porter St., Lansing, Mich.
Send me without obligation literature and prices on Novo Hoists. Size_____
Name_____
Address_____
City_____
State_____

Genuine O. AMES

THE SHOVEL THAT BUILT AMERICA

First manufactured in 1774, Genuine O. Ames shovels are still the leading Plain Backs.

The famous Ames Bend, often copied but never equalled, gives to this pioneer shovel, a perfect balance—and that means greater shoveling ease.

Electric welded straps assure a permanent, not a temporary connection—Armor-D handles—Label die embossed—all exclusive "Ames" features.

Time-tested Special Alloy Steel gives longer wear.

ASK YOUR JOBBER

A BW

O. AMES
RED EDGE
PONY
BALDWIN
KNOX-ALL
BRONCO
MONONGAH
HUSKY
PEERLESS
3-STAR
PINNACLE
2-STAR

SINCE 1774

AMES BALDWIN WYOMING CO.
PARKERSBURG, W. VA. NORTH EASTON, MASS.

EQUIPMENT and MATERIALS

An index of products made by manufacturers whose advertisements appear in this issue of Construction Methods.

If you do not find all you need in the advertising section, we shall be glad to assist you. Write to—

CONSTRUCTION METHODS
Information Bureau
330 West 42nd St. New York City

ASPHALT
Texas Company

ASPHALT PLANTS
Blaw-Knox Company
Hetherington & Berner, Inc.

BACK FILLERS
Harnischfeger Corp.
Link Belt Co.
Northwest Engineering Co.

BARGES, CONCRETE AND STEEL
Jones & Laughlin Steel Co.

BARS, IRON AND STEEL
Bethlehem Steel Co.
Inland Steel Co.
Jones & Laughlin Steel Co.

BATCHERS, ADJUSTABLE MEASURING
Blaw-Knox Company

BELTING
Goodall Rubber Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.

BINS, STORAGE
Blaw-Knox Company
Chain Belt Company
Ransome Concrete Mchry. Co.

BLASTING, ACCESSORIES
Atlas Powder Co.
Du Pont de Nemours & Co., E. I.
Ensign-Bickford Co.

BOLTS, NAILS, NUTS, RIVETS and SPIKES
Bethlehem Steel Co.
Inland Steel Co.
International Nickel Co., Inc., The

BOOKS, ENGINEERING
McGraw-Hill Book Co.

BOOTS, RUBBER
Goodall Rubber Co.

BUCKETS
Blaw-Knox Company
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Mfg. Company
Northwest Engineering Co.
Owen Bucket Co.
Page Engineering Co.
Ransome Concrete Mchry. Co.

BUILDINGS, STEEL
Blaw-Knox Company

BULLDOZERS
Baker Mfg. Co.
Le Tourneau, Inc., R. G.

CABLEWAYS
Roebling Son's Co., J. A.

CABLE, ELECTRIC
General Electric Co.
Roebling Son's Co., J. A.

CALCIUM CHLORIDE
Calcium Chloride Ass'n.

CARS, AIR DUMP, INDUSTRIAL, ETC.
Bethlehem Steel Co.

CASTINGS, IRON & STEEL (alloy)
International Nickel Co., Inc., The

CEMENT
Lone Star Cement Corp.
Portland Cement Assoc.
Universal Atlas Cement Co.
(U. S. Steel Corp. Subsidiary)

CEMENT (BULK) HANDLING EQUIP.
Barber-Greene Co.
Blaw-Knox Company
Chain Belt Company

CHAIN STEEL & MALLEABLE SPROCKET
Chain Belt Company
Link Belt Co.

CHUTES, CONCRETE
Insley Manufacturing Co.
Ransome Concrete Mchry. Co.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co.
General Electric Co.
Novo Engine Co.
Schramm, Inc.

CONCRETE CURING MATERIAL
Calcium Chloride Ass'n.

CONCRETE REINFORCEMENT
Inland Steel Co.
Jones & Laughlin Steel Co.
Wickwire Spencer Steel Co.

CONCRETE SLAB RAISING EQUIPMENT
Koehring Company

CONVEYING & STORAGE SYSTEMS
Barber-Greene Co.
Chain Belt Company
Link Belt Co.

CONVEYORS, BELT, BUCKET & CHAIN
Barber-Greene Co.
Chain Belt Company
Link Belt Co.
Wickwire Spencer Steel Co.

CRANES, GAS, ELECTRIC, DIESEL & STEAM
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Clyde Sales Co.
Harnischfeger Corp.
Koehring Company
Link Belt Co.
Michigan Power Shovel
Northwest Engr. Co.
Thew Shovel Co.
Universal Crane Co.

CRANES, MOTOR TRUCK
Thew Shovel Co.
Universal Crane Co.

CRUSHERS & PULVERIZERS
Acme Road Mchry. Co.
Allis-Chalmers Mfg. Co.
Galion Iron Wks. & Mfg. Co.

CULVERTS
Armco Culvert Mfrs. Ass'n.

CUTTING TOOLS, PORTABLE HAND
Porter, H. K.

DERRICKS & DERRICK FITTINGS
Clyde Sales Co.
Dobbie Fdry. & Machine Co.
Harnischfeger Corp.

DRAGLINES
(See Cranes & Shovels)

DRAWING PAPER
Wade Instrument Co.

DREDGES
Bucyrus-Erie Co.
Harnischfeger Corp.

DRILLS
Schramm, Inc.

DRILLS, WAGON
Bucyrus-Erie Co.

DYNAMITE
Atlas Powder Co.
Du Pont de Nemours & Co., E. I.

ELEVATORS, BUCKET
Chain Belt Company
Link Belt Co.

ELEVATORS, CONTR. MATERIAL
Barber-Greene Co.
Chain Belt Company
Galion Iron Wks. & Mfg. Co.
Link Belt Co.
Ransome Concrete Mchry. Co.

ENGINES, PORTABLE
Allis-Chalmers Mfg. Co.

ENGINES, STATIONERY, DIESEL & GAS
Caterpillar Tractor Co.
Novo Engine Co.

EXCAVATORS, DITCH & TRENCH
Baker Mfg. Co.
Barber-Greene Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Koehring Company
Link Belt Co.
Northwest Engr. Co.
Thew Shovel Co.
Universal Crane Co.

EXCAVATORS, DRAGLINE
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Mfg. Company
Koehring Company
Link Belt Co.
Northwest Engr. Co.
Novo Engine Co.
Page Engineering Co.
Thew Shovel Co.
Universal Crane Co.

EXPANDED METAL
Bethlehem Steel Co.

EXPLOSIVES
Atlas Powder Co.
Du Pont de Nemours & Co., E. I.

FLOODLIGHTS
General Electric Co.

FLOORING
Barrett Company
Texas Company

FLOOR PLATES, STEEL
Inland Steel Co.

FORGINGS
International Nickel Co., Inc., The

FORMS, CONCRETE
Blaw-Knox Company

FORMS, PIPE
Quinn Wire & Iron Wks.

FUSE, BLASTING
Atlas Powder Co.
Ensign-Bickford Co.

GENERATORS, ELECTRIC
Electric Tamper & Equipment Co.
General Electric Co.

GRADES, ROAD
Acme Road Mchry. Co.
Allis-Chalmers Mfg. Co.
Blaw-Knox Company
Caterpillar Tractor Co.
Galion Iron Wks. & Mfg. Co.

GRAVEL WASHING PLANTS
Galion Iron Wks. & Mfg. Co.

GRINDERS
White Manufacturing Co.

GUARD RAILS, HIGHWAY
American Cable Co.
Wickwire Spencer Steel Co.

HOISTS, GAS, ELECTRIC, DIESEL & STEAM
Allis-Chalmers Mfg. Co.
Clyde Sales Co.
Construction Machinery Co.
Dobbie Fdry. & Machine Co.
Harnischfeger Corp.
Novo Engine Co.
Sterling Machinery Corp.

HOISTS, HAND
Chain Belt Company
Coffing Hoist Co.
Sterling Machinery Corp.

HOSE, AIR, WATER & STEAM
Goodall Rubber Co.
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.

INSERTS, CONCRETE
Bethlehem Steel Co.

JACKS
Construction Specialties Co.

JOINTS, PAVING
Barrett Company
Texas Company

LATH, EXPANDED METAL
Wickwire Spencer Steel Co.

LIGHTING PLANTS
General Electric Co.
Novo Engine Co.
Sterling Machinery Corp.

LINER PLATES, STEEL
Blaw-Knox Company
Ingot Iron Rlwy. Products Co.

LOADERS, PORTABLE
Barber-Greene Co.
Link Belt Co.

LOCOMOTIVES
General Electric Co.

LUBRICANTS
Gulf Refining Co.
Roebling Son's Co., J. A.
Texas Company

MAINTAINERS, ROAD
Allis-Chalmers Mfg. Co.
Galion Iron Wks. & Mfg. Co.

MIXERS, CONCRETE & MORTAR
Chain Belt Company
Construction Machinery Co.
Jaeger Machine Co.
Koehring Company
Ransome Concrete Mchry. Co.
Smith Co., The T. L.

MIXERS, PAVING
Chain Belt Company
Koehring Company
Ransome Concrete Mchry. Co.
Smith Co., The T. L.

MIXERS, TRUCK
Blaw-Knox Company
Chain Belt Company
Jaeger Machine Co.

MIXING PLANTS, CENTRAL
Blaw-Knox Company
Chain Belt Company
Jaeger Machine Co.
Ransome Concrete Mchry. Co.
Smith Co., The T. L.

MOTORS, ELECTRIC
General Electric Co.
Harnischfeger Corp.

PAINTS
Barrett Company
Du Pont de Nemours & Co., E. I.

PAINTS, WATERPROOFING
Sika, Inc.

PAVEMENT BREAKERS
Schramm, Inc.

PAVING, COLD PATCHING
Texas Company

PAVING, HAND TOOLS
L & M Mfg. Co.

PILE DRIVERS
Harnischfeger Corp.
Link Belt Co.

PILING, INTERLOCKING STEEL
Bethlehem Steel Co.
Inland Steel Co.
Jones & Laughlin Steel Co.

PIPE, DRAIN
Armco Culvert Mfrs. Ass'n.

PIPE FORMS, CONCRETE
Quinn Wire & Iron Wks.

PIPE INSTALLATION METHODS
Armco Culvert Mfrs. Ass'n.
Hydranger Corp.

PIPE, METAL
Jones & Laughlin Steel Co.

PLATES, STEEL
Inland Steel Company

POWDER
Atlas Powder Co.
Du Pont de Nemours & Co., E. I.

PULLERS, HAND-POWER PORTABLE
Edelblute Mfg. Co.

PUMPS, PORTABLE
Chain Belt Company
Construction Machinery Co.
Gorman-Rupp Co.
Jaeger Machine Co.
Moretrench Corp.
Novo Engine Co.
Sterling Machinery Corp.

PUMPS, STATIONARY
Allis-Chalmers Mfg. Co.
Chain Belt Company
Novo Engine Co.
Sterling Machinery Corp.

RAIL & RAIL JOINTS, FASTENINGS & SPECIALTIES
Bethlehem Steel Co.
Inland Steel Company

ROAD OIL & PRESERVATIVES
Barrett Company
Texas Company

ROAD FINISHERS & MACHINES, CONCRETE
Blaw-Knox Company

ROAD SURFACING HARROWS
Insley Manufacturing Co.

ROLLERS ROAD
Galion Iron Wks. & Mfg. Co.

ROOFING
Barrett Company
Texas Company

ROPE, WIRE
American Cable Co.
Roebling Son's Co., J. A.
Wickwire Spencer Steel Co.

SAW RIGS, PORTABLE
Chain Belt Company
Construction Machinery Co.
Sterling Machinery Corp.

SAWS, PORTABLE ELECTRIC AND AIR DRIVEN
Reed-Prentice Corp.

SCRAPERS, SCARIFIERS & PLOWS
Baker Mfg. Co.
Euclid Road Mchry. Co.
Galion Iron Wks. & Mfg. Co.
Harnischfeger Corp.

SCREENS, SAND, GRAVEL & COAL
Acme Road Mchry. Co.
Link Belt Co.
Wickwire Spencer Steel Co.

SHEETS, IRON & STEEL
Bethlehem Steel Co.

SHORES, ADJUSTABLE
Construction Specialties Co.

SHOVELS, HAND
Ames Baldwin Wyoming Co.

SHOVELS, POWER
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Manufacturing Co.
Koehring Company
Link Belt Co.
Michigan Power Shovel
Northwest Engr. Co.
Thew Shovel Co.
Universal Crane Co.

SNOW PLOWS & LOADERS
Baker Mfg. Co.
Galion Iron Wks. & Mfg. Co.

SPREADERS, BALLAST
Bucyrus-Erie Co.

SPREADERS, BITUMINOUS SURFACE
Barber-Greene Co.
Jaeger Machine Co.

SPREADERS, SAND, GRAVEL & STONE
Galion Iron Wks. & Mfg. Co.

STEEL, ALLOY
International Nickel Co., Inc., The

STEEL, STRUCTURAL
Bethlehem Steel Co.
Inland Steel Company
Jones & Laughlin Steel Co.

TAR
Barrett Company

TARPAULINS
Fulton Bag & Cotton Mills

TIRES, TRUCK
Goodrich Rubber Co., B. F.
Goodyear Tire & Rubber Co.

TOOLS, PNEUMATIC
Schramm, Inc.

TRACKS, INDUSTRIAL PORTABLE
Bethlehem Steel Co.
Jones & Laughlin Steel Co.

TRACTORS, DIESEL & GAS
Allis-Chalmers Mfg. Co.
Caterpillar Tractor Co.
Cleveland Tractor Co.

TRAILERS, DUMP & CRAWLER WHEEL
Allis-Chalmers Mfg. Co.
Austin-Western Road Mchry. Co.
Euclid Road Mchy. Co.
LeTourneau, Inc., R. G.

TRUCKS, MOTOR
Euclid Road Mchy. Co.

VENTILATING TUBES
Du Pont de Nemours & Co., E. I.

VIBRATORS, CONCRETE
Electric Tamper & Equipment Co.
White Manufacturing Co.

WAGONS, DUMP & CRAWLER WHEEL
Allis-Chalmers Mfg. Co.
Euclid Road Mchy. Co.
Koehring Company
LeTourneau, Inc., R. G.

WATERPROOFING
Barrett Company
Sika, Inc.
Texas Company

WELDING & CUTTING APPARS.
General Electric Co.
Harnischfeger Corp.

WELDING RODS & WIRE
Roebling Son's Co., J. A.
Wickwire Spencer Steel Co.

WELLPOINT SYSTEMS
Chain Belt Company
Complete Mchry. & Equip. Co., Inc.
Moretrench Corp.

WINCHES
Dobbie Fdry. & Machine Co.

WIRE ROPE ACCESSORIES
American Cable Co.
Roebling Son's Co., J. A.

WOOD PRESERVATIVES
Barrett Company

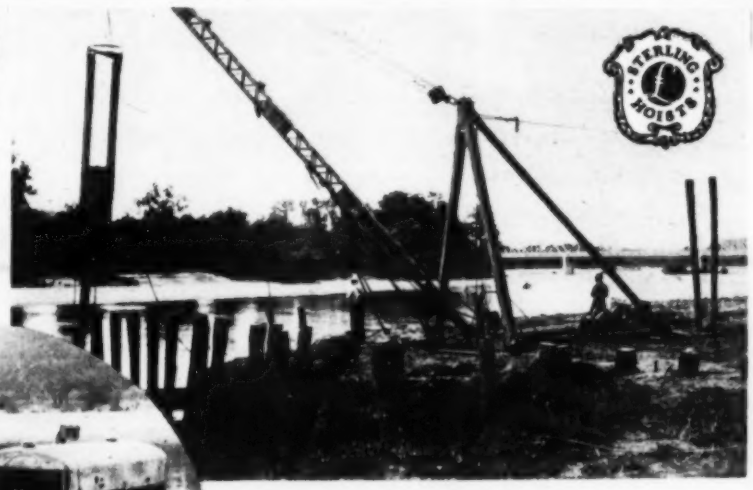
WRENCHES
Greene-Tweed & Co.
Trimont Mfg. Co.

For page reference see advertisers index, page 86

STERLING HOISTS

FULLY DEVELOPED — THOROUGHLY TRIED AND PROVEN

Used and recommended by leading contractors everywhere



SIMPLE — RUGGED DEPENDABLE

Patented Improved Screw Thrust

Positive Clutch Release

Cut Tooth Gears

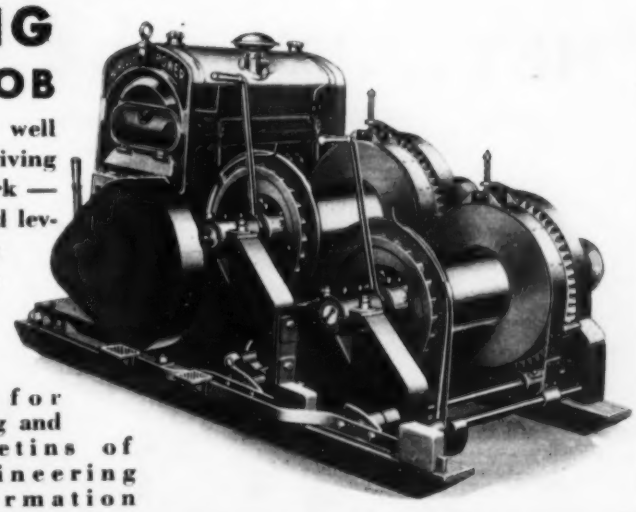
High Carbon Ground Precision Shafts

Johns-Manville Asbestos Frictions

Alemite-Zerk Lubrication

STERLING ON THE JOB

Sterling Hoists are well adapted for pile driving — drag scraper work — building bridges and levees — elevator work — and other construction jobs.



Sterling
MACHINERY CORPORATION
411-13 Southwest Blvd. Kansas City, Mo.

Ask for catalog and bulletins of Engineering Information

CONSTRUCTION METHODS ADVERTISERS IN THIS ISSUE

Acme Road Machry. Co. 82
Allis-Chalmers Mfg. Co. ... Center Spread
Ames Baldwin Wyoming Co. 83
American Cable Co. ..... 3rd Cover
Armco Culvert Mfrs. Assn. 67
Atlas Powder Co. 21

Baker Mfg. Co. 72
Barber-Greene Co. 61
Barrett Company 17
Bay City Shovels, Inc. 69
Bethlehem Steel Co. 62
Blaw-Knox Company 70
Bucyrus-Erie Co. 65

Calcium Chloride Assn. 79
Caterpillar Tractor Co. 9
Chain Belt Co. ..... 4th Cover
Cleveland Tractor Co. 81
Clyde Sales Co. 76
Coffing Hoist Co. 66
Columbia Alkali Corp. 79
Commercial Invest. Trust Corp. 73
Complete Mchry. & Equip. Co., Inc. ... 82
Construction Machinery Co. 59
Construction Specialties Co. 76

Dobbie Fdry. & Mach. Co. 66
Dow Chemical Co. 79
du Pont de Nemours & Co., E. I. 56

Edelblute Mfg. Co. 82
Electric Tamper & Equip. Co. 82
Ensign-Bickford Co. 18
Equipment Acceptance Corp. 73
Euclid Road Mchry. Co. 5

Fulton Bag & Cotton Mills 82

Galion Iron Wks. & Mfg. Co. 16
General Electric Co. 6
Goodall Rubber Co. 68
Goodrich Rubber Co., B. F. 71
Goodyear Tire & Rubber Co. 57
Gorman Rupp Co. 74
Greene, Tweed & Co. 64
Griffin Wellpoint Corp. 82
Gulf Refining Co. 23

Harnischfeger Corp. ..... 2nd Cover
Hetherington & Berner, Inc. 70
Hydrauger Corp., Ltd. 82

Ingot Iron Rlwy. Products Co. 64
Inland Steel Co. 22
Insley Manufacturing Corp. 80
International Nickel Co., Inc., The ... 12

Jaeger Machine Company 15
Jones & Laughlin Steel Corp. 78

Koehring Company 58-59

L & M Mfg. Company 82
Le Tourneau Inc., R. G. 8
Link-Belt Company 14
Lone Star Cement Corp. 7

McGraw Hill Book Co. 74
Michigan Alkali Co. 79
Michigan Power Shovel Co. 80
Moretrench Corp. 59

Northwest Engrg. Co. 13
Novo Engine Co. 83

Owen Bucket Co. 76

Page Engineering Co. 77
Porter, H. K. 68
Portland Cement Assn. 75

Quinn Wire & Iron Works 82

Ransome Concrete Mchry. Co. 72
Reed-Prentice Corp. 68
Roebling Sons Co., J. A. 20
Rogers Bros. Corp. 76

Schramm, Inc. 66
Searchlight Section 82
Service Section 82
Sika, Inc. 72
Smith Co., The T. L. 63
Solvay Sales Corp. 79
Sterling Machinery Corp. 85

Texas Company 10-60
Thew Shovel Co. 19
Trimont Mfg. Co. 70

U. S. Steel Corp. Subsidiary 24
Universal Atlas Cement Co. 24
Universal Crane Co. 19

White Manufacturing Co. 82
Wickwire Spencer Steel Co. 11

"HEY...Why be a *Borrow-Buzzard?*"

THIS COUPON SAVES THE BOTHER OF BORROWING—AND BRINGS YOU YOUR OWN COPY OF CONSTRUCTION METHODS EACH MONTH—WITH A HOST OF NEW FEATURES YOU'LL WANT TO KEEP FOR REFERENCE

CONSTRUCTION
METHODS
330 West 42nd St., New York, N. Y.

I want to save $1 on a subscription at the Special Two Year Rate of $3. (Check here ☐ if you prefer one year — 12 issues — for $2.)

Name .....
Address .....
City ..... *State* .....
Company ..... *Position* .....

MAIL TODAY

IT'S "IDEA INSURANCE"

TRU·LAY *Preformed* IS ITS OWN BEST SALESMAN

GREEN SIGNIFIES SAFETY

Here is *another* place where one Tru-Lay wire rope merits another.

The first Tru-Lay Preformed installed as a tower moving line gave such exceptional service that when finally worn out another was ordered and installed. . . . Then a third—fourth—fifth—etc. At the time this is written the eighth consecutive Tru-Lay is being used.

There is neither sentiment nor salesmanship in wire rope service. A rope either gives the best service—or it doesn't. The constant re-ordering of Tru-Lay Preformed from users everywhere proves conclusively its all-around superiority.

AMERICAN CABLE COMPANY, Inc.

Wilkes-Barre, Pennsylvania

An Associate Company of the American Chain Company, Inc.

IN BUSINESS FOR YOUR SAFETY

District Offices: Atlanta, Chicago, Detroit, Denver, New York, Philadelphia, Pittsburgh, Houston, San Francisco

TRU·LAY *Preformed* Wire Rope

✲ ALL AMERICAN CABLE COMPANY ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE EMERALD STRAND

AGAIN ON THE GREATEST BRIDGE OF 1936 IT PAID *to Forget the* OLD STUFF

At pouring time, Rex Moto-Mixers, loaded at the mixing plant, three-quarters of a mile away, are feeding concrete into the Pumpcrete hoppers.

The Pumpcrete pipe line, supported by a light steel truss, extended over the water 350 feet, to carry the pumped concrete into position for placing.

The Pumpcrete delivering the concrete to a floor hopper on a barge anchored near the pier forms. There, a crane and bucket completed the pouring into the forms.

● Concreting of the piers, in Little Hell Gate's rushing waters with tidal currents and flood waters to combat, presented one of the most interesting, difficult and spectacular feats in the construction of the famous Triborough Bridge in New York.

Old-time methods went into the discard with the installation of a Rex Dual Pumpcrete on the banks of Little Hell Gate.

● In concreting the deck of the Manhattan Approach, a Rex Pumpcrete, located at the foot of one of the piers, and fed by four Rex Moto-Mixers, pumped the concrete up to the deck, in one day pumping 728 cubic yards of concrete for an average of 47.73 yards per hour.

On Randall's Island, three Rex Moto-Mixers mixed and delivered 360 cubic yards of concrete to twelve scattered piers in ten hours.

In the construction of this $60,300,000.00 bridge, opened to traffic on July 11, Rex Moto-Mixers also mixed and delivered concrete for the following important contracts: the Land Piers on Ward's Island, the Multi-ramped Traffic Sorter on Randall's Island and the Landscaping of the Manhattan Approach.

CHAIN BELT COMPANY
1664 West Bruce St. Milwaukee, Wis.

Concrete by Pipe Line *with* REX PUMPCRETE